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## The Amphibian Fauna of Thailand

BY

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**ABSTRACT.** The Amphibian fauna of Thailand is reviewed on the basis of collections made in Thailand in 1957-1958 and in 1959-1960, chiefly by the author.

The following forms are described as new:

*Leptobrachium minimum*, *Leptobrachium hendricksoni*, *Rhacophorus bisacculus*, *Theloderma stellatum*, *Theloderma gordonii*, and *Microhyla inornata lineata*.

Three generic names have been revived:

*Hazelia* Taylor has been revived for *Philautus pictus* (Peters) and *Hazelia spinosa* Taylor. *Theloderma* has been revived for certain arboreal Rhacophorids formerly considered under *Rhacophorus* and *Philautus*, species that have a very rough surface. They lay four to eight eggs (perhaps more in some cases) in trees, above cavities containing water. They may or may not have vomerine teeth.

*Leptobrachium* is revived for certain *Pelobatids* sometimes considered under the genera *Megophrys* (a composite genus) and *Xenophrys*. The four Thai species are *L. hasseltii*, *pelodytoides*, *minimum*, and *hendricksoni*.

Frogs formerly regarded as belonging to *Chirixalus* are here treated in the genus *Philautus*, for the reason that the limits of the two genera are as yet not clearly drawn.

The number of species and subspecies treated in the work is 100. However, two are of doubtful validity or of doubtful occurrence.

Practically all forms are described, and illustrated with black and white photographs.

## TABLE OF CONTENTS

	PAGE
ORDER CAUDATA (Salamanders) .....	278
FAMILY SALAMANDRIDAE .....	278
Genus TYLOTOTRITON Anderson .....	278
<i>Tylototriton verrucosus</i> Anderson .....	279
ORDER SALIENTIA (Frogs and toads) .....	282
FAMILY PELOBATIDAE .....	283
Genus MEGOPHRYS Kuhl .....	284
<i>Megophrys nasuta</i> (Schlegel) .....	284

	PAGE
<i>Megophrys aceras</i> (Boulenger) . . . . .	287
<i>Megophrys longipes</i> (Boulenger) . . . . .	291
<i>Megophrys carinensis</i> (Boulenger) . . . . .	292
<i>Megophrys feae</i> (Boulenger) . . . . .	296
<i>Megophrys parva</i> (Boulenger) . . . . .	299
<i>Megophrys major</i> (Boulenger) . . . . .	302
Genus LEPTOBRACHIUM Tschudi . . . . .	307
<i>Leptobrachium hendricksoni</i> sp. nov. . . . .	308
<i>Leptobrachium hasseltii hasseltii</i> Müller, in Tschudi . . . . .	312
<i>Leptobrachium pelodytoides</i> Boulenger . . . . .	317
<i>Leptobrachium minimum</i> sp. nov. . . . .	320
FAMILY BUFONIDAE . . . . .	322
Genus BUFO Laurenti . . . . .	323
<i>Bufo macrotis</i> Boulenger . . . . .	324
<i>Bufo asper</i> Gravenhorst . . . . .	326
<i>Bufo parvus</i> Boulenger . . . . .	329
<i>Bufo melanostictus</i> Schneider . . . . .	332
Genus PEDOSTIBES Günther . . . . .	335
<i>Pedostibes hosii</i> (Boulenger) . . . . .	336
Genus ANSONIA . . . . .	339
<i>Ansonia penangensis</i> Stoliczka . . . . .	339
FAMILY ATELOPODIDAE . . . . .	341
Genus CACOPHRYNE Davis . . . . .	342
<i>Cacophryne borbonica</i> (Boie) . . . . .	342
FAMILY HYLIDAE . . . . .	344
Genus HYLAE Laurenti . . . . .	345
<i>Hyla annectens</i> (Jerdon) . . . . .	345
FAMILY RANIDAE . . . . .	346
Genus OOEIDOZYGA Kuhl and van Hasselt . . . . .	346
<i>Oocidozyga lima</i> Kuhl and van Hasselt . . . . .	347
Genus PHRYNOGLOSSUS Peters . . . . .	350
<i>Phrynoglossus magnapustulosus</i> (Taylor and Elbel) . . . . .	351
<i>Phrynoglossus martensii</i> Peters . . . . .	353
<i>Phrynoglossus laevis</i> Günther . . . . .	353
Genus ELACHYGLOSSA Andersson . . . . .	360
<i>Elachyglossa gyldestolpei</i> Andersson . . . . .	360
Genus RANA . . . . .	362
<i>Rana cyanophlyctis cyanophlyctis</i> Schneider . . . . .	365
<i>Rana tigerina pantherina</i> (Fitzinger) . . . . .	368
<i>Rana rugulosa</i> Wiegmann . . . . .	371
<i>Rana raja</i> M. Smith . . . . .	373
<i>Rana cancrivora</i> Gravenhorst . . . . .	377
<i>Rana limnocharis limnocharis</i> Gravenhorst . . . . .	380
<i>Rana macrodon</i> Kuhl, in Tschudi . . . . .	383
<i>Rana blythii</i> Boulenger . . . . .	386
<i>Rana doriae</i> Boulenger . . . . .	390
<i>Rana macrognathus macrognathus</i> Boulenger . . . . .	395
<i>Rana kochangae</i> M. Smith . . . . .	393
<i>Rana pileata</i> Boulenger . . . . .	398



	PAGE
<i>Rana plicatella</i> Stoliczka	401
<i>Rana laticeps</i> Boulenger	405
<i>Rana kuhlii</i> Schlegel, in Duméril and Bibron	408
<i>Rana hascheana</i> Stoliczka	412
<i>Rana erythraea</i> (Schlegel)	417
<i>Rana macrodactyla</i> (Günther)	421
<i>Rana cubitalis</i> M. Smith	424
<i>Rana miopus</i> Boulenger	427
<i>Rana nicobariensis nicobariensis</i> (Stoliczka)	430
<i>Rana chalconota</i> (Schlegel)	433
<i>Rana glandulosa</i> Boulenger	436
<i>Rana nigrovittata</i> (Blyth)	440
<i>Rana lateralis</i> Boulenger	443
<i>Rana aenea</i> M. Smith	446
<i>Rana signata</i> (Günther)	448
<i>Rana luctuosa</i> (Peters)	451
<i>Rana alticola</i> Boulenger	453
<i>Rana tasanae</i> M. Smith	456
<i>Rana tenasserimensis</i> Sclater	459
<i>Rana jerboa</i> (Günther)	462
<i>Rana hosii</i> Boulenger	465
<i>Rana livida</i> (Blyth)	468
<i>Rana scutigera</i> Andersson	471
Genus STAUROIS Cope	473
<i>Staurois afghanus</i> (Günther)	474
<i>Staurois larutensis</i> Boulenger	477
FAMILY RHACOPHORIDAE	480
Genus RHACOPHORUS Kuhl	480
<i>Rhacophorus nigropalmatus</i> Boulenger	482
<i>Rhacophorus robinsoni</i> Boulenger	485
<i>Rhacophorus binaculatus</i> Boulenger	487
<i>Rhacophorus dulitensis prominans</i> (M. Smith)	491
<i>Rhacophorus bisacculus</i> sp. nov.	494
<i>Rhacophorus leucomystax leucomystax</i> (Kuhl, in Gravenhorst),	496
<i>Rhacophorus leucomystax sexvirgatus</i> (Reinwardt, in Graven-	
horst)	500
<i>Rhacophorus colletti</i> Boulenger	501
Genus HAZELIA Taylor	505
<i>Hazelia picta</i> (Peters)	506
Genus THELODERMA Tschudi	509
<i>Theلودerma gordonii</i> sp. nov.	511
<i>Theلودerma stellatum</i> sp. nov.	514
<i>Theلودerma horridum</i> Boulenger	517
<i>Theلودerma asperum</i> (Boulenger)	519
Genus PHILAUTUS Gistel	522
<i>Philautus parvulus</i> (Boulenger)	523
<i>Philautus hansenae</i> Cochran	526
<i>Philautus vittatus</i> (Boulenger)	529
<i>Philautus nongkhorensis</i> Cochran	531

	PAGE
<i>Philautus bimaculatus</i> (Peters) .....	534
<i>Philautus doriae</i> (Boulenger) .....	537
FAMILY MICROHYLIDAE .....	539
Genus MICROHYLA Tschudi .....	539
<i>Microhyla annectens</i> Boulenger .....	540
<i>Microhyla annamensis</i> M. Smith .....	542
<i>Microhyla inornata inornata</i> Boulenger .....	543
<i>Microhyla inornata lineata</i> subsp. nov. ....	546
<i>Microhyla pulchra</i> (Hallowell) .....	548
<i>Microhyla ornata</i> (Duméril and Bibron).....	551
<i>Microhyla heymonsi</i> Vogt .....	554
<i>Microhyla butleri</i> Boulenger .....	557
<i>Microhyla berdmorei</i> (Blyth) .....	560
Genus KALOULA Gray .....	563
<i>Kaloula pulchra pulchra</i> Gray .....	563
<i>Kaloula mediolincata</i> M. Smith .....	566
Genus CALLUELLA Stoliczka .....	569
<i>Calluella guttulata</i> (Blyth) .....	569
Genus KALOPHRYNUS Tschudi .....	572
<i>Kalophrynus pleurostigma pleurostigma</i> Tschudi .....	573
Genus GLYPHOGLOSSUS Günther .....	575
<i>Glyphoglossus molossus</i> Günther .....	576
ORDER GYMNOPTIONA .....	579
FAMILY CAECILIDAE .....	582
Genus ICHTHYOPHIS Fitzinger .....	582
<i>Ichthyophis acuminatus</i> Taylor .....	583
<i>Ichthyophis supachaii</i> Taylor .....	586
<i>Ichthyophis youngorum</i> Taylor .....	588
<i>Ichthyophis kohtaoensis kohtaoensis</i> Taylor .....	592
<i>Ichthyophis kohtaoensis</i> subsp.? .....	594

## INTRODUCTION

The work involved in preparing this review of the herpetology of Thailand was undertaken at the specific request of Professor Supachai Vanijuvadhana, Secretary General of Chulalongkorn University, Bangkok, Thailand, who has himself long been interested in the Thai faunas.

The Fulbright Foundation in Thailand, through the kind offices of Professor Supachai, helped to expedite a Fulbright Grant which was made available to me for the period from September, 1957, to June, 1958, and made possible my journey to Thailand. In July, 1958, I found that it was imperative for me to return to America to resume my work at the University of Kansas.

A year later another similar request caused me to apply for a second Fulbright Grant. This was readily made available to me for

another ten-months period beginning July, 1959, and was later extended to September, 1960.

Thus a total of 24 months was spent in Thailand. Of this period, approximately 13½ months were devoted to exploration and collecting in various parts of the country.

One is scarcely aware of the size of Thailand from an examination of an ordinary map of Asia, and one is usually surprised to learn that from north to south the country measures over 1,000 miles, and the east-west measurement is more than half this distance. But once realizing the size of the country it becomes evident that no adequate sampling of the fauna could be done in a single year of exploration.

Many areas must be investigated, many mountain tops attained, and much work both day and night must be expended before one might say the sampling was adequate.

The remainder of my time, some ten and a half months, was spent in Bangkok, the time devoted to a study of the collections and the preparation of the manuscripts.

For the most part this publication follows the over-all design for the study agreed upon by Dr. Supachai and the author. While this was not specific in detail it was proposed that the fauna be considered in three groups: first, a volume treating exclusively of the Amphibians; another dealing with the Lizards, Turtles, and Crocodiles; and a third with the Serpents.

M. L. Pootipong Nupartpat Varavudhi—an instructor in Chulalongkorn University—was assigned to accompany me on my earlier journeys of exploration, and proved to be an excellent companion. I have had most excellent help and numerous specimens from Mr. Oliver Gordon Young of Chiang Mai, and his father, Mr. Harold Young.

I also find myself under considerable obligation to Dr. Boonsong Lekagul, Secretary General of the Association for the Conservation of Wildlife, both for his companionship on numerous collecting trips and for numerous specimens.

The design of this work does not permit the inclusion of a very considerable body of notes on the specimens collected. These have in a measure been sacrificed to have space for illustrations, since pictures may be regarded as a universal language substitute. While the illustrations can scarcely be regarded on a par with color photographs, one is more often concerned with the identification of preserved specimens, in which case the illustration in color may be

no more serviceable than the black and white illustrations offered here.

No effort has been made to provide complete synonymies or literature lists, the titles listed frequently being works dealing with the species as it occurs in Thailand or adjoining countries. With regard to distribution I have, for the most part, been content to list the changwats or provinces where specimens are known, rather than list all exact localities at which specimens have been taken; although frequently exact localities are given of specimens where this data is pertinent.

Elsewhere more details are given regarding the materials used. On my leaving Thailand Dr. Supachai provided for a division of the collections, giving to me a considerable portion of the collection.

Unless otherwise stated all specimen numbers are those of Chulalongkorn University.

Finally I must offer my sincerest gratitude to the Rector of the University, Air Marshal Muni M. Vejyant-Rangvrisht, and especially to Dr. Supachai Vanijvadhana its Secretary General for the opportunity to undertake this task; for their untiring and prompt concern with my needs; and for their delightful hospitality in this land of Freedom and Smiling.

LAWRENCE, KANSAS,

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## TAXONOMIC CONSIDERATION

### AMPHIBIA

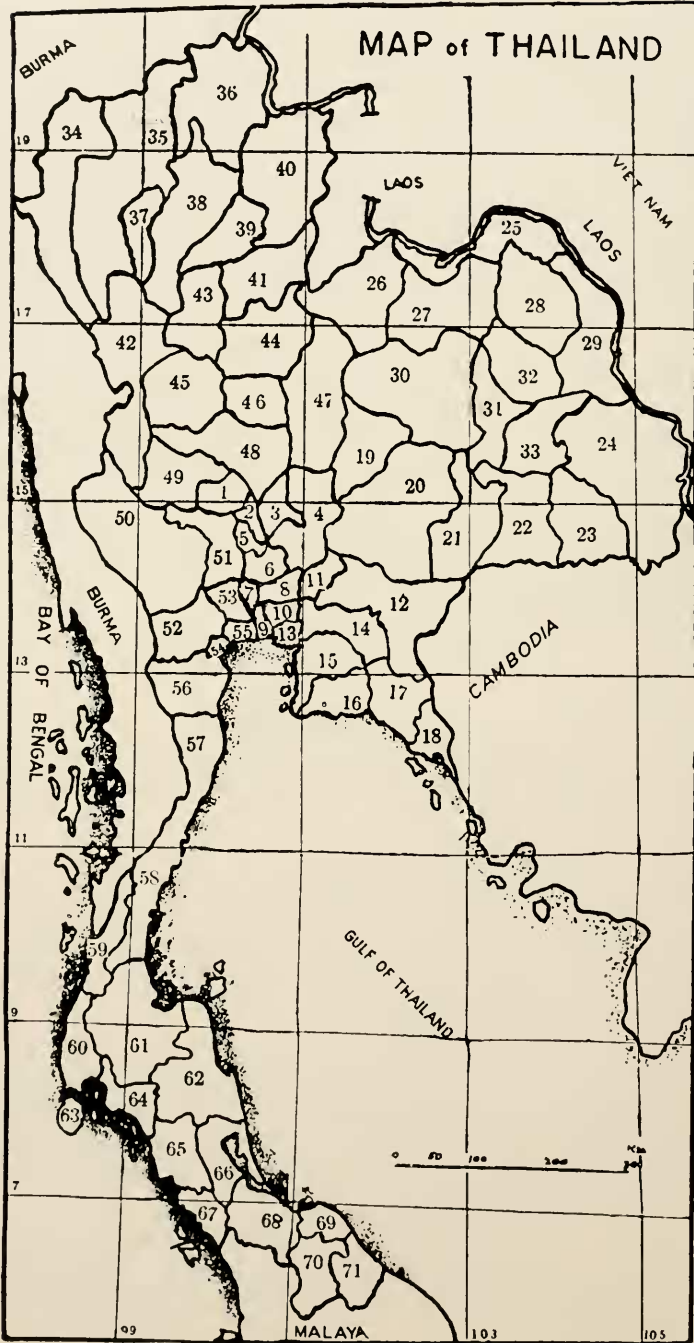
The amphibia, a very early vertebrate group of land animals, are probably less numerous than they have been in the past. Certain orders such as the Labrithodontia, Phyllospondyli, and Lepospondyli, are extinct.

Three orders of amphibia, however, are living. These are Caudata, Salientia, and Gymnophiona.

The Caudata have retained what we are wont to consider as generalized characters; retention of limbs (rarely lost), retention of the tail, and a moderately elongated body; and the retention of teeth in both jaws (occasionally absent).

The Salientia have, however, become greatly modified and are not generalized. The legs are retained in all cases but the body form has become especially shortened; the number of vertebrae greatly reduced; the legs greatly enlarged in proportion to the arms; the teeth have, with rare exception, been lost in the lower jaw and the tail has been lost in the adult.

Despite this great specialization, these animals must be regarded as plastic and while retaining these specialized characters, may otherwise adapt themselves to many varieties of habitats. They



MAP No. 1.—Provinces (Changwats) of Thailand. The numbers refer to the numbered list of provincial names, and have no significance in themselves.



LIST OF THAI PROVINCES

(Corrected spellings as used by the U. S. Army Gazetteer, 1944)

- |                                |                         |
|--------------------------------|-------------------------|
| 1. Chainat                     | 37. Lamphun             |
| 2. Sing Buri                   | 38. Lampang             |
| 3. Lop Buri                    | 39. Phrae               |
| 4. Sara Buri                   | 40. Nan                 |
| 5. Ang Thong                   | 41. Uttaradit           |
| 6. Ayutthaya                   | 42. Tak                 |
| 7. Nonthaburi                  | 43. Sukhothai           |
| 8. Pathum Thani                | 44. Phitsanulok         |
| 9. Thon Buri                   | 45. Kamphaeng Phet      |
| 10. Phra Nakhon (Bangkok)      | 46. Phichit             |
| 11. Nakhon Nayok               | 47. Phetchabun          |
| 12. Prachin Buri               | 48. Nakhon Sawan        |
| 13. Samut Prakan               | 49. Uthai Thani         |
| 14. Chachoengsao               | 50. Kanchanaburi        |
| 15. Chon Buri                  | 51. Suphan Buri         |
| 16. Rayong                     | 52. Rat Buri            |
| 17. Chanthaburi                | 53. Nakhon Pathom       |
| 18. Trat                       | 54. Samut Songkhram     |
| 19. Chaiyaphum                 | 55. Samut Sakhon        |
| 20. Nakhon Ratchasima (Khorat) | 56. Phet Buri           |
| 21. Buriram                    | 57. Prachuap Khiri Khan |
| 22. Surin                      | 58. Chumphon            |
| 23. Khu Khan (Sisaket)         | 59. Ranong              |
| 24. Ubon                       | 60. Phangnga            |
| 25. Nong Khai                  | 61. Surat Thani         |
| 26. Loei                       | 62. Nakhon Si Thammarat |
| 27. Udon Thani                 | 63. Phuket              |
| 28. Sakon Nakhon               | 64. Krabi               |
| 29. Nakhon Phanom              | 65. Trang               |
| 30. Khon Kaen                  | 66. Phatthalung         |
| 31. Maha Sarakham              | 67. Satun               |
| 32. Kalasin                    | 68. Songkhla            |
| 33. Roi Et                     | 69. Pattani             |
| 34. Mae Hong Son               | 70. Yala                |
| 35. Chiang Mai                 | 71. Narathiwat          |
| 36. Chiang Rai                 |                         |

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As for the spelling of Thai names, I am using the scheme of transliteration from the Thai alphabet adopted by the Thai Government nearly two decades ago, and likewise used in the U. S. Army Gazetteer of 1944. This often is at variance with spellings encountered in European or older American maps, or in other reports. An effort should be made to stabilize the system of transliteration.



have been very successful and considerable more than two thousand forms are known and doubtless many are still undiscovered.

The life history pattern in many forms has been varied and while normally the amphibian requires a free swimming stage, very many forms pass the larval stage entirely in the egg, the young emerging with arms and legs developed and the tail reduced or lost. There is a world of variety in the life histories of this group. The eggs are deposited in water, in masses of foam, in shrubs and trees, or on the ground in holes in the earth, in pockets on the body, in vocal sacs, in trees above small pockets of water or retained in the "uterine" oviduct where a type of placentation occurs.

A few forms have developed a certain tolerance to sodium chloride, even going into the sea to feed.

The Gymnophiona also have become highly specialized through the loss of both arms and legs, the total, or almost total loss of the tail, the increase in the length of the body, and the development of serpentine locomotion, the transverse folding of the skin and loss or concealment of scales, the reduction of the eye, and the retention of teeth in both jaws (two series in the upper jaw and one or two in the lower).

This group, too, has been successful. It has distributed itself throughout much of the tropical and subtropical areas of the world.

Perhaps as many as 125 species are known and I suspect many are still undiscovered. The fact that at the present time only a single family is recognized, is suggestive that they all originated from and have diversified from a monophyletic group.

#### CAUDATA

The world-wide distribution of this order of Amphibia follows an unusual pattern. They are wide-spread in the Northern Hemisphere, but completely absent in the Southern Hemisphere except for a few plethodontid salamanders that follow the Andes south to Bolivia and perhaps one species, that has been reported from the Amazon Basin. While present in Siberia, China, and Japan, they are absent in much of southern Asia. None are not known from Arabia, Iran, and India, while in Burma, Thailand, and Indo-China they are known only in the northern parts. They are again absent in Malaya, the Philippines and the Indo-Australian Archipelago.

Only a single genus and species has been found in Thailand. This is *Tylototriton verrucosus* a form entering from the north and as yet known only from high elevation in mountainous areas in the

province of Chiang Mai. There is, of course, a possibility of finding other species of salamanders since but little exploration has been undertaken in the higher areas. Yunnan, lying to the north of Thailand, has *Cynops*, another genus represented, while in the Indo-Chinese area another genus, *Paramesotriton*, is present, and *Tylotriton* is represented by a different species, *T. asperrimus*.

A species of *Ambystoma* reported by Gray from Siam in 1859 was found to be actually a mislabeled American species, *A. jeffersonianum*.

While most Caudata have retained the generalized pattern, certain forms have become burrowers with the consequent reduction or loss of digits and limbs; others live entirely in water.

Many forms have become neotenic, attaining sexual maturity and reproducing in the larval state or at least before the complete transformation to a terrestrial form takes place. Sometimes the larval condition retained may be that of external gills. Sometimes it is the fins or the larval condition of the teeth that is retained; and in the case of *Thorius* the bones of the skull appear to remain in the larval condition.

#### GYMNOPHIONA

The Gymnophiona are less familiar to most persons than are the frogs, since they are subterranean in habitat and often when one is seen it is likely to be regarded merely as an earthworm, which they resemble superficially.

This group has undergone a remarkable evolution since we must postulate that these animals came from four-limbed ancestors as is true of all the terrestrial vertebrates. The loss of digits and limbs are the end result of mutations selected by the burrowing habitat.

The method of locomotion has changed and a curious change has taken place at the surface of the body. This is the "folding" of the skin as if by a system of "tucks." The "seams" are indicated by the small grooves that separate one fold from another and the curious scales, if present, are covered by the fold. The number of the grooves may exceed 400. Sometimes the number of scalar rows exceeds 1,000.

An intromittent organ has developed from the posterior part of the gut, an organ that is extruded by infiltrating it with blood, making possible internal fertilization of the eggs. The loss of the tail or almost complete loss of the tail, would permit copulation between male and female even if only the ends of the two bodies were together.

When I have found these animals in burrows the diameter of the burrow is scarcely larger than the diameter of the body and while larger burrows may exist I have found none of a diameter that would permit two animals to copulate when their bodies were parallel side by side. The position in copulation must still be determined.

The inner wall of the male gut is modified posteriorly by thickened areas forming a more or less symmetrical pattern, that at least in many cases, may serve as a distinguishing specific character. In various genera the character may likewise serve to distinguish genera.

The mode of life history varies in the Gymnophiona. Eggs are usually if not universally fertilized internally. They may be deposited in moist places under rocks, in moist burrows near streams, directly in the water, or they may be retained in the oviduct, the young being born in an advanced larval stage.

Most of the species spend a part of their larval life as free swimming larvae, breathing through gills, although a very considerable part of development will have taken place within the egg itself.

In the larval state the lateral-line system may function if the animal is aquatic. It may appear only in the earlier larval stages or it may be retained until the larvae undergo transformation to the adult form. It may be presumed that if so retained the animal is an inhabitant of deeper river water.

One behavioral feature in the sole Thai genus *Ichthyophis* is the parental care bestowed on eggs, at least in certain species. The female of *Ichthyophis youngorum* places the eggs under a rock near the edge of a stream, the eggs being fastened together by threads two or more centimeters in length, like so many diminutive toy balloons. The following illustrates this behavior.

A rock was turned. The female did not attempt escape but remained with the eggs. When the eggs were transferred to a container partly filled with earth the female was picked up gently. Her struggles were negligible and when placed in the container with the eggs she found them and by placing her head under them, turned each egg so that it attained a different position. This was continued perhaps ten or fifteen minutes then she became quiescent.

In this case the eggs contained embryos about 40 mm. long and the movement of the material in the eggs always left the embryo uppermost in the egg regardless of the position in which it was placed; at least the position of the embryo did not change when the egg was rotated.

There is a surprising specific constancy in many of the characters. The arrangement, number, and distribution of the scales; the characteristics of the vent, the number of folds on the tail, its shape and length, and the position of the teeth.

The numbers of the teeth vary from youth to age, and often the larvae will have specialized teeth that are lost during larval existence. Some of these teeth may appear outside the lips and in one case have been reported as serving the larvae in rasping off parts of the uterine surface in order that it may feed upon it.

#### SALIENTIA

The Salientia, by far the largest living amphibian group, are generally familiar to the people. They have developed a voice and in the case of the males of many species, vocal sacs that open into the mouth through one or two openings.

The sac may be under the skin of the throat and when inflated may form a large pouch on the throat. There may be two sacs that push out through the skin of the floor of the mouth or behind the angle of the jaw on the side of the head.

The openings to the vocal sacs, seen on the inside of the mouth may be elongate slits, short slits or small puckered openings. They may be easily visible in the mouth lying close to the lower jaw, or they may be far back in the mouth near the jaw-angle and difficult to discover. Many species lack the sac in the male. It is not present in females.

Determination of the sex of a specimen is not always easy save by dissection and even then hermaphroditic individuals still offer problems in sexing.

Usually in adults the presence of a vocal sac or sacs or the presence of a nuptial pad on the first finger or specialized groups of spines, which may extend on to second and third fingers, betoken the male.

In most species the female reaches a larger size than the male. Rarely there is a difference in the amount of webbing on the fingers or on the toes. Occasionally marked sexual differences are evident in the two sexes as regards color and marking (see *Pedostibes*).

The nuptial pad of the first finger may be absent. Often glands on the inner part of the arm seem to serve the same purpose as the nuptial pad or groups of spines. If the forms are large and arboreal the male may develop a conspicuous bony spine on the innerside of the first finger that may serve as a safer clasping organ.

For the most part eggs are deposited in the water and are fer-

tilized by the clasping male as the eggs are extruded by the female. Some of the frogs have developed a technique of egg deposition out of the water. In certain tree frogs the eggs are placed on the under side of leaves close to or above water. When the young hatch they fall into water from the eggs. In other cases gelatinlike material extruded with the eggs is churned up by the legs of the male and deposited in the form of a ball of foam in plants, shrubs, or trees, occasionally as much as six meters above water.

### ORDER CAUDATA (Salamanders)

Four limbs are usually present, rarely only two; young pass through a larval state in which they breathe by gills, followed by a complete (or partial) metamorphosis. Some forms remain in the larval state throughout life; tail retained, not absorbed at transformation; eggs placed in water for hatching.

Nine families are recognized: Hynobiidae, Cryptobranchidae, Amphiumidae, Ambystomidae, Salamandridae, Desmognathidae, Plethodontidae, Proteiidae, and Sirenidae.

Only a single salamander species is known from Thailand. It is a high mountain dweller, as yet found in Thailand only on isolated mountain peaks, in the northern part of the country.

### FAMILY SALAMANDRIDAE

Of the Caudata only the Family Salamandridae is represented in Thailand. A species described from Thailand as *Plethodon persimile* Gray, (1859), was placed in the genus *Ambystoma* family Ambystomidae by Boulenger. It has since been discovered by Noble, (1926), that the specimen so described actually originated in the United States and is a synonym of *Ambystoma jeffersonianum*.

### *Tylotriton* Anderson

*Tylotriton* Anderson, Proc. Zool. Soc. London, 1871, p. 423; Anatomical and Zoological researches and Zoological results of the Yunnan Expeditions; Reptilia and Amphibia, 1878-1879 (1879), p. 848 (type, *verrucosus*); Boulenger, Catalogue of the Batrachia Gradientia s. Caudata and Batrachia Apoda in the collection of the British Museum, 2nd ed., 1882, p. 29.

*Tylotriton* Boettger, Offenb. Ver. Naturk., vol. 24/25 1885, p. 165 (emendation).

*Diagnosis:* Tongue small, subcircular, free laterally, and slightly so posteriorly; prevomerine teeth in two oblique series meeting anteriorly; a thick bony frontosquamosal arch; maxillary reaching quadrate; pterygoid applied to maxillary; four fingers; five toes; tail strongly compressed.



*Tylototriton verrucosus* Anderson

FIG. 0

*Tylototriton verrucosus* Anderson, Proc. Zool. Soc. London, 1871, p. 423, pl. 76, fig. 6, pl. 77; Anatomical and zoological researches and zoological results of the Yunnan Expeditions; Reptilia and Amphibia, 1878-1879, (1879), p. 848 (type locality Nantun, Momien [Tengyueh] and Hotha valleys, Western Yunnan); Boulenger, Catalogue of the Batrachia Gracientia s. Caudata and Batrachia Apoda in the collection of the British Museum, 2nd Ed., 1882, p. 29; Brown, Rec. Ind. Mus., vol. 5, 1910, pp. 193-196; Annandale, Rec. Ind. Mus., vol. 6, 1911, p. 215; Boulenger, Bull. Soc. Zool. France, vol. 45, 1920, p. 98; M. Smith, Rec. Ind. Mus., vol. 26, pt. 4, 1924, pp. 309-310 (Chiang Dao, N. Thailand elev. 5000-6000 ft., larvae); Schmidt, Bull. Amer. Mus. Nat. Hist., vol. 54, 1927, p. 555; Pope, Bull. Amer. Mus. Nat. Hist., vol. 61, 1931, p. 430; Fang and Chang, Cont. Metro. Mus. Nat. Hist. Acad. Sinica, vol. 2, 1932, p. 121; Peking Nat. Hist. Bull., vol. 15, pt. 1, 1940, p. 20; Liu, Fieldiana, Zool. Mem., vol. 2, June 15, 1950, pp. 108-109; Wahlert, Zool. Jahrb. (Anat.), vol. 73, 1953, p. 285 (various other references in paper); Chang, Contribution à l'étude morphologique biologique et systématique des amphibiens urodeles de la Chine, Paris, 1936, p. 89.

*Diagnosis:* Maxillary-premaxillary teeth 55, those on the premaxillary largest; vomeropalatine teeth in a continuous series lying parallel anteriorly and diverging posteriorly; tongue circular, free on sides, fastened anteriorly; crown of head flattened, depressed in frontal and interorbital areas; sides of head with bony and glandular areas elevated to level of upper eyelid; nostrils near tip of snout directed forward; body above with two series of rounded knoblike tubercles; tail laterally compressed.

*Description of species* (from No. 36104; Doi Intanon, Chiang Mai, Thailand, 2000 m.; collected by Mrs. Birgit Degerbøl Hansen): Head bluntly oval almost truncate; strong canthal ridge begins at snout and passes back of eye, terminating in a thickened glandular area (resembling a paratoid gland) the end of which is narrowed and bent somewhat upward. A depression lies between these ridges; eye moderate, its length approximately equal to length of snout; nostrils directed laterally and somewhat forward; prevomerine teeth in two elongate series on inner edges of bones, at first nearly parallel and contiguous, then diverging, their posterior parts somewhat salient. Choanae situated close to orbit, with deep groove directed outwards and somewhat backwards; tongue relatively small; maxillary and premaxillary teeth present.

Dorsum with a median ridge beginning on occiput and continuing to tail where it narrows, becoming continuous with a rather high dorsal fin on tail; beginning above arm, series of rounded dorso-lateral knoblike glandular tubercles extend to level of posterior end of vent; a slight ridge distinguishable beyond this, producing a slight thickening far onto tail near its ventral level.



FIG. 0.—*Tylototriton verrucosus* Anderson. No. 36164. Actual total length, 130 mm., Doi Intanon, circa 2000 m. elev., Chiang Mai, Thailand.



Arms rather short, with four digits, their tips darkened and rounded; legs pentadactyl, median digit longest; digits somewhat flattened, tips narrowed, somewhat rounded; vent swollen, its inner lips papillate. Tail with well-defined dorsal fin five millimeters high at base; ventral fin obsolete, indicated only by fine median ventral ridge.

Skin of body and tail finely granular; granules present on venter except in median area which has fine transverse folds; granules on underside of digits and on underside of tail.

*Color:* Above dark brown; glands on side of neck and dorsolateral region lighter brown; tail generally lighter brown than body, becoming cream on ventral surface; area about vent, rusty cream; underside of digits, palms, and soles dull cream; chin, venter, and sides nearly black.

*Measurements in mm.:* Snout to termination of vent, 68; tail, 62; snout to arm-insertion, 21; axilla to groin, 30; width of head, 16.8; length of head, 16; arm, 20; leg, 21.5.

*Variation:* The color may be uniform blackish brown, paler on lips, snout, chin, throat, and undersurface of limbs, all of which are of a brownish-olive tinge. The undersurface of the tail may be dull orange.

*Distribution:* Aside from the single collection of larvae by Dr. Malcolm Smith's collector [on mountain near] Chiang Dao at an elevation of 5000 to 6000 ft., the one recorded here from Doi In-tanon, is the only one known from Thailand. Both localities are in Chiang Mai Province. This species has a range from western Yunnan and northern Burma west to Sikkim. It reaches an elevation above 6000 ft.

*Remarks:* Concerning the development of the larvae, Smith (1924) writes: "The eggs of this newt are large although somewhat variable in size, measuring, when the gelatinous envelope is fully distended by the developing embryo, between 6 and 10 mm. in diameter. The young one on emerging is about 11 mm. long and is provided with well-developed external gills, with a pair of elongated 'balancers' originating from a point behind and below the eye and in a line with the continuation of the mouth backwards, with a crested tail and budding fore-limbs. These latter develop rapidly and all four legs, with their digits, are complete at quite an early stage in life. The 'balancers' apparently soon disappear, although a trace of them often persists in the form of a small tubercle at their point of origin."

There are normally three gills on each side. The Thai specimens tend to lose the gills when they have attained a length of 52 mm. However, some retained the gills when they were 75 mm. in length.

### ORDER SALIENTIA

Four limbs are universally present; tail absent in adults (except *Ascaphus*); vertebrae of adults reduced to less than 11; teeth absent from lower jaw (with rare exception), present or absent on maxillary and premaxillary; often absent from vomers. Progression normally made by leaping. A free-swimming stage is normal for larvae, but many frogs pass through the larval stages in the egg and are terrestrial when they leave the egg. Certain ones are known in which the young develop in pockets in the skin, in vocal sacs, or in uteri. In Thailand, the following Anuran families are known: Pelobatidae, Atelopodidae, Bufonidae, Hylidae, Ranidae, Rhacophoridae, and Microhylidae. Only a single species each of the Hylidae and Atelopodidae are known to occur, while approximately 40 species of the Ranidae are known.

#### KEY TO THE FAMILIES OF SALIENTIA

1. Pectoral girdle arciferal ..... 2  
    Pectoral girdle firmisternal ..... 4
2. Terminal phalanges claw-shaped; maxillary (and premaxillary) teeth present; sacral diapophyses expanded; an intercalary cartilage or bone between the two terminal phalanges; arboreal ..... Hylidae  
    Terminal phalanges not claw-shaped; no intercalated bone or cartilage between two distal phalanges ..... 3
3. Maxillary teeth present; vomerine teeth present or absent; chiefly terrestrial ..... Pelobatidae  
    No maxillary teeth present; no vomerine teeth; chiefly terrestrial, ..... Bufonidae
4. Maxillary teeth present; usually vomerine teeth also; diapophyses of sacral vertebra cylindrical or at most only very slightly dilated ..... 5  
    Maxillary teeth absent (except *Caluella* in Asiatic species); sacral diapophyses expanded ..... 6
5. No intercalated bone or cartilage between last two phalanges on each digit; terrestrial ..... Ranidae  
    An intercalated cartilage or bone between the two distal phalanges on each digit; arboreal ..... Rhacophoridae
6. Slender species, not squat or toadlike; no maxillary or vomerine teeth; coecyx and sternum fused; no intercalary cartilages between distal phalanges, no omosternum; vertebral column procoelous; sternum slender ..... Atelopodidae  
    Squat toadlike species; without maxillary teeth (in Thai species) except *Caluella*; terminal phalanges simple or T-shaped; sternal apparatus variable. Tadpole without horny mandibles or external teeth, ..... Microhylidae

FAMILY PELOBATIDAE

Amphibians somewhat toadlike in appearance with arciferal pectoral girdle; ends of sacral vertebra strongly widened; vomerine teeth present or absent; coracoids and precoracoids present, curved. A cartilaginous omosternum and sternum entirely cartilaginous or with a bony style.

Vertebrae anomocoelous, (amphicoelous, procoelous, or opisthocelous), the vertebral discs often not attaching to the centrum. Teeth are present in upper jaw (except *Aelurophryne*); vomerine teeth present or absent.

These primitive amphibians have been treated variously. Noble has proposed the recognition of three subfamilies *Megophryinae*, *Pelobatinae*, and the *Sooglossinae*. The arrangement of the known genera in the subfamily groups follows:

MEGOPHRYINAE	PELOBATINAE	SOOGLOSSINAE
<i>Megophrys</i> Kuhl and van Hasselt	<i>Scaphiopus</i> Holbrook	<i>Sooglossus</i>
<i>Leptobrachium</i> Tschudi	<i>Pelobates</i> Wagler	<i>Nesomantis</i>
<i>Nesob'ia</i> van Kampen	[ <i>Macropelobates</i> ] Noble	
<i>Scutiger</i> Theobald	<i>Spea</i>	
<i>Aelurophryne</i> Boulenger		
<i>Leptobrachella</i> M. Smith		
<i>Vibrissaphora</i> Liu		

Boulenger in 1908 (Proc. Zool. Soc. London, pp. 407-430, pls. 22-25) reviewed the Asiatic frogs previously classified under the genera *Leptobrachium* and *Megophrys* (*Megalophrys* of Boulenger since he did not recognize the older name of Kuhl and van Hasselt, which although older [1822], he placed under the synonymy of *Megalophrys* [1824]). He points out that the belief held by Cope and himself that *Megalophrys* had only opisthocelous vertebrae was untrue. Beddard, studying the anatomy of *M. nasuta* had pointed out that the vertebrae in his specimen had procoelous vertebrae, a statement which Boulenger confirmed. Further he found procoelous vertebrae in some *M. montana*, the type of the genus, and in *M. longipes*. In others of the same species they were opisthocelous. He states: "It is therefore clear that the character, however important it may appear at first is worthless even as a specific character in these Batrachians."

While it may be regarded as unfortunate that this important vertebral character is not stable enough to be used to separate *Leptobrachium* from *Megophrys* it must be conceded that a number of other differential characters are available for such a separation, and doubtless others will be found when more skeletal material is available for study.

## GENUS MEGOPHRYS KUHL

## KEY TO THAI GENERA OF PELOBATIDAE

Vomerine teeth absent, tongue broad, notched behind, free for more than half its length; two very strongly distinct metacarpal tubercles,

*Leptobrachium*

Vomerine teeth present; tongue not notched behind, not or scarcely free behind; none or only a very indistinct metacarpal tubercle . . . . . *Megophrys*

## KEY TO THE THAI SPECIES OF MEGOPHRYS

1. Upper eyelid with long or short pointed dermal appendage, or with one or more pointed tubercles on eyelids . . . . . 2  
     Upper eyelid lacking a dermal "spine" or pointed tubercles . . . . . 6
2. A dermal appendage on edge of eyelid, also sometimes one on tip of snout; snout projecting beyond mouth . . . . . 3  
     Eyelid with one or several pointed tubercles. Head greatly depressed, . . . . . 5
3. An elongate dermal appendage on edge of eyelid, one on snout-tip; bony deposits in skin above head and front part of body fusing with bones in adults; tibiotarsal articulation reaching near to commissure of jaws; a vocal sac present. Tympanum dim or hidden; length 125 mm. . . . . *nasuta*  
     A short dermal appendage (rarely also one on tip of snout) tympanum more or less distinct . . . . . 4
4. Old specimens with bony deposits on head; male without a vocal sac; heel reaches to near angle of jaw; snout to vent, 78 mm. . . . . *aceras*  
     No bony deposits about head or anterior part of back; heel reaches beyond tip of snout, 65 mm. . . . . *longipes*
5. Eyelid with two to four pointed tubercles near edge; vomerine teeth normally present; heel to shoulder or jaw-angle; skin with bony deposits about head and anterior part of body; a vocal sac and paired elongate glandular folds on back. Male, 123 mm., female, 150 mm. . . . . *carinensis*  
     Eyelid with small tubercles, and one much more elongate than others; no longitudinal glandular folds on dorsum; a vocal sac; tibiotarsal articulation reaches near jaw-angle; bony deposits on head; length 106 mm. . . . . *feae*
6. Smaller, snout-vent length to 52 mm.; tibiotarsal articulation reaches to eye or near it; male with nuptial rugosities on first and second finger; a slight rudiment of web on foot . . . . . *parva*  
     Larger, to 90 mm.; tibiotarsal articulation to near nostril, to tip of snout or beyond; foot about one-fourth to one-third webbed, the web reaching discs as a fringe . . . . . *major*

*Megophrys nasuta* (Schlegel)

## FIG. 1

*Ceratophryne montana* var. Schlegel, Abbildungen neuer oder unvollständig bekannter Amphibien . . . 1837, p. 30.

*Ceratophryne nasuta* Schlegel, Handl. Dierk, vol. 2, 1858, p. 57, pl. 4, fig. 72 (type locality, Sumatra).

*Megalophrys montana* (non Kuhl) Cantor, Journ. Asiat. Soc. Bengal, vol. 16, 1847, p. 1061; Günther, The reptiles of British India, 1864, p. 413 (*part.*).

*Megalophrys montana* var. *nasuta* Cantor, Journ. Asiat. Soc. Bengal, vol. 16, 1847, p. 1061.

- Megalophrys nasuta* Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 11, 1873, p. 419; Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum, 1882, p. 443; Flower, Proc. Zool. Soc. London, 1900, p. 889; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1904, p. 339; Boulenger, Proc. Zool. Soc. London, 1908, p. 413, pl. 22; A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 279-280, fig. 77; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 2, Dec. 1916, p. 170 ("Tanjong Mas, Patani"); *ibid.*, vol. 2, no. 3, May, 1917, p. 231.
- Megophrys nasuta* M. Smith, Bull. Raffles Mus., no. 3, Apr. 1930, p. 132; Nieden, Das Tierreich, Lief. 46, Anura I, 1923, pp. 54-55, fig. 108; Bourret, Les Batraciens de l'Indochine, 1942, pp. 195-197.

**Diagnosis:** Head broad, snout with elongate free dermal flap; eyelids with soft hornlike appendages, equal or nearly equal in length to length of eye; usually a fold across back border of occiput; two dorsolateral ridges on back; canthus sharp, loreal region oblique, concave; first finger equal to or shorter than second; white glandular spot on breast below arm insertion; a pair of glandular white spots on posterior face of thigh; tibiotarsal joint extending to between eye and tympanum; latter small, far from eye.

**Description of species** (from 34666, near Bhetong, Yala Province): Head very large, (41 mm. x 30 mm. measured to back of jaw); head above limited by a curving fold of skin; snout truncate anteriorly, but with a soft hornlike appendage extending from tip; canthus rostralis sharp, loreal region oblique, distinctly concave; sharp, nearly parallel, slightly overhanging folds or ridges from eyes to above tympani; area between this fold and flaring edge of lower jaw shallowly concave; upper eyelid terminating in a dermal spine, strongly projecting, the length of lid and spine together equal to or slightly less than interorbital distance, which is depressed or concave between orbits and canthi; tympanum diagonally placed, rounded below, somewhat angular on upper edge, separated from eye by a distance greater than greatest diameter of tympanum. Choanae rather small, lateral, when palate is viewed directly from below, choanae largely concealed; vomerine teeth on two parallel ridges arising very near inner anterior edge of choanae, scarcely reaching beyond their posterior level, separated from each other by a distance greater than length of one ridge; openings of Eustachian tubes much smaller than choanae; large vocal sac opening through small puckered openings somewhat in front of mouth-angle; palatal glands with a well-defined pair of openings in palate at anterior level of choanae. Tongue small, not or minutely nicked behind, free behind for half or more of its length, largely free on sides; tongue subcircular, attached to front of jaw by a narrow forward projection seven millimeters long.





FIG. 1.—*Megophrys nasuta* (Schlegel). No. 34666 ♂. Actual snout-vent length, 82 mm. Bhetong, Yala, Thailand.

Arm moderate, first finger longer than second; fingers feebly widened at tips, lacking trace of webs; toes with tips similar to those of fingers, but with definite web-remnant (less than one-fourth webbed); digits lacking lateral ridges; no subarticular tubercles, but underside of all digits with low calloused ridges; large inner metacarpal tubercle; elongate inner metatarsal tubercle, no outer; tibio-tarsal articulation reaches to tympanum; when legs are folded at right angles to body, heels fail to touch by distance of seven millimeters.

Skin above generally smooth; upper eyelids corrugated, with a median diagonal ridge; a pair of fine longitudinal folds begin at occiput and continue to near groin, the folds closer together anteriorly and posteriorly than on middle of dorsum. A pair of rounded tubercles on shoulders and one on rump; two or three dermal spines near jaw-angle and behind it; a pair of glands on breast below arm-insertion; side with few scattered glandular tubercles; a gland on back face of femur with some indistinct glandules below vent; chin and venter more or less irregularly granulate, especially laterally; some tubercles on legs; diagonal ridges across tibia.

*Color:* Above brown, darker on sides of head and on snout; a triangular area of lighter brown between eyes; area between folds on back blackish, somewhat mottled, darker than mottled areas on each side; anteriorly this darker area dividing and extending onto eyelids; chin, throat, and breast blackish; venter, underside of arm, and leg whitish with spots or clouding of blackish-brown; region of vent black-brown; back of thigh a brownish network, enclosing numerous whitish flecks and cream-colored glands; large dark spot under foot; tarsus bordered by whitish stripe.

Measurements in mm. of *Megophrys nasuta*

Number.....	34666	34667	34664	M 137	M 80
Sex.....	♂	♂	♂	♂	♀
Snout to vent.....	82	72	75	77	135
Width of head.....	41	37	36.2	37	61
Length of head.....	30	28	28	29	43
Interorbital width.....	12.5	10.5	11.5	12.5	18
Length of eye.....	9	8	8	9	12.5
Arm.....	52	46	51	48	67
Leg.....	94	95	94.4	88	126
Tibia.....	31	27.5	29	28	42.5
Foot and tarsus.....	44.5	41	41	39	57

*Megophrys aceras* (Boulenger)

FIG. 2

*Megalophrys montana* Flower, Proc. Zool. Soc. London, 1899, p. 914 (type locality, Perak, Malaya); Laidlaw, *ibid.*, 1900, pp. 889; Butler, Journ. Bombay Nat. Hist. Soc., 1904, p. 399; Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 22; Boulenger, Proc. Zool. Soc. London, 1908, p. 411 (*part.*); A vertebrate fauna of the Malay peninsula . . . Reptilia and Batrachia, 1912, pp. 277-278 (*part.*); Nieden, Das Tierreich, Lief. 46, Anura I, 1923, pp. 52-54 (*part.*).

*Megalophrys montana aceras* Boulenger, Fasciculi Malayenses; Zoology, vol. 1, 1903, p. 131, pl. 5, fig. 1.



- Megalophrys montana* M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 2, Dec. 1916, p. 170 (Khao Wang Hip, upper camp, 800-900 m. NE "Tung Sawang," Nakhon Si Thammarat); *ibid.*, vol. 2, no. 3, May, 1917, p. 231; *ibid.*, vol. 2, no. 4, Dec., 1917, pp. 271-272 (Doi Nga Chang, N. Siam).
- Megalophrys aceras* M. Smith, Proc. Zool. Soc. London, 1926, pp. 983, 987, 988 (a species separate from *montana*, the latter not occurring in the Malay peninsula); Bull. Raffles Mus., 1930, pp. 132-133 (Pattani); Bourret, Les Batraciens de l'Indochine, 1942, pp. 192-194, fig. 37.

*Diagnosis:* Tongue entire or feebly notched posteriorly; interorbital distance greater than width of eyelid; interorbital region distinctly concave; canthus sharp; tympanum present, far from eye; first finger not, or but slightly longer than second; subarticular tubercles lacking; belly with small tubercles; male without vocal sac; vomerine teeth present; a pair of dorsolateral glandular folds and transverse fold behind occipital region; very short dermal "horn" on eyelid.

*Description of species* (from Boulenger 1912): Head very much widened, one and one-half to one and three-quarter times as wide as long; usually a transverse fold behind occipital region; snout truncate, or somewhat obtusely pointed, projecting beyond lower jaw, as long as or a little shorter than eye; canthus rostralis sharply defined; loreal region vertical anteriorly, somewhat oblique posteriorly, the region concave; interorbital distance one and one-half to twice width of upper eyelid, the region distinctly concave; tympanum not distinct, rarely hidden, its diameter one-half to two-thirds times that of eye; vomerine teeth in small widely separated groups, just behind level of choanae; tongue entire or feebly nicked behind; no vocal sac in males.

Fingers obtuse or slightly swollen at tips; first finger as long as or a little longer than second; no subarticular tubercles or distinct metacarpal tubercles; toes short, obtuse, feebly swollen at tips with mere rudiment of web, or at most one-fourth webbed; no subarticular tubercles, but a flat indistinct metatarsal tubercle; tibiotarsal articulation extending to shoulder, angle of jaws, or temporal area; tibia three-eighths to one-half snout-to-vent length; foot as long as or shorter than tibia.

Skin above smooth, or with some scattered conical warts or tubercles. Old specimens with bony deposits on head and anterior part of back; strong fold extending from eye above tympanum to shoulder; sometimes more than one fold on each side; usually one on each side of back; upper eyelid with short horn not exceeding two-thirds diameter of eye; limbs usually with oblique transverse glandular ridges; venter with small tubercles.



FIG. 2.—*Megophrys aceras* (Boulenger). EHT-HMS No. 6232. Actual snout-vent length, 53 mm. Mts., Nakhon Si Thammarat, Thailand.

*Color:* Uniform olive-brown above, or variously marked with darker or lighter shades; large triangular dark spot more or less distinct between eyes, base forward; dark oblique bar below eye; transverse dark bars on limbs more or less distinct; lower parts pale brown, spotted and marbled with blackish; white gland on each side of breast.

*Measurements in mm.:* Snout to vent, 88.

*Distribution:* The species is known from southern peninsular Thailand. Known also in Malaya.

*Remarks:* I have followed Smith and Bourret in recognizing *aceras* as a distinct species. It has been found at considerable elevation in the mountains. The light spot (tubercle) mentioned by Boulenger is a gland.

Postfemoral glands are present, and a pair of glands on breast; *M. aceras* and *nasuta* occur in the same territory.

### *Megophrys longipes* (Boulenger)

FIG. 3

*Megalophrys longipes* Boulenger, Proc. Zool. Soc. London, 1885, p. 850, pl. 55 (type locality, "mountains of Perak, Straits of Malacca, 3300 ft."); Günther, Ann. Mag. Nat. Hist., ser. 5, vol. 20, 1887, p. 316; Butler, Journ. Bombay, Soc. Nat. Hist., vol. 15, 1904, p. 400; Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 29; Boulenger, Proc. Zool. Soc. London, 1908, p. 415 (revision of genus); A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 280 (mountains of Perak, 3000-4500 ft., and Gunong Angsi, Negri Sembilan, 2600 ft.); Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 282 (Fraser's Hill).

*Megophrys longipes* Smith, Bull. Raffles Mus., no. 3, 1930, p. 132.

*Diagnosis:* A small soft spine on outer edge of upper eyelid; vomerine teeth present; snout projecting beyond jaw; toes with slight rudiment of web; tibiotarsal articulation reaching beyond tip of snout; gland on posterior surface of thigh; vocal sac in male.

*Description of species* (from type description): Tongue pyriform, indistinctly nicked posteriorly; vomerine teeth in two small groups just behind line of posterior borders of choanae; head broader than long, much depressed; snout very short, obliquely truncate, concave above and on sides, with strong canthus rostralis; nostril equally distant from eye and middle of rostral extremity; interorbital space concave, a little broader than upper eyelid; tympanum distinct, oval, its distance from eye exceeds its greatest diameter. Arm long and slender, the first finger extending beyond second. Leg very long, the extremity of femur reaching shoulder; tibiotarsal articulation reaching far beyond tip of snout; toes slender, swollen at tips



FIG. 3.—*Megophrys longipes* (Boulenger). Type. From Boulenger, Proc. Zool. Soc. London, 1885, p. 850, pl. 55. Actual length, 60 mm. Mountains of Perak, Malaya.

with a slight rudiment of a web. Subarticular tubercles lacking; no metatarsal tubercles.

Skin smooth above, with small warts on flanks, and two pairs of delicate oblique folds converging posteriorly on the scapular region; fold extending from eye above tympanum to shoulder; upper eyelid with small hornlike tubercle on outer edge; lower surfaces smooth.

*Color:* Olive-brown above, sides of head speckled with blackish, and with oblique yellowish vertical bars; digits with yellowish cross-bars; on hinder side of thighs upper half reddish brown, lower part blackish brown, the two colors sharply separated; lower surface pale reddish brown, largely marbled and spotted dark brown.

*Measurements in mm.* (male and female, respectively, from Boulenger, 1908): Snout to vent, 47, 65; length of head to occiput, 14, 19; width of head, 17, 23; length of snout, 4, 6; diameter of eye, 5, 6; arm, 31, 43; leg, 83, 118; tibia, 27, 38; foot, 22, 33.

*Distribution:* In Thailand specimens have been captured on Khao Luang, Nakhon Si Thammarat, at 4000 feet elevation. In Malaya it has been taken at the type locality, Mountains of Perak, where it is common.

*Variation:* The first finger may equal or exceed length of second.

*Remarks:* "Mr. Butler has observed it to be the commonest frog on the hills above 3000 ft., and to be entirely nocturnal, being found in the daytime under logs, rocks, or in holes in banks, and in densely shaded spots among dead leaves . . . When seized in the hand they frequently open their mouths wider for some seconds. Mr. Butler has never seen this frog enter water of its own accord and he suspects very large ova ( $\frac{1}{2}$ -inch in diameter) containing tadpoles with the hind limbs and tail well developed, which he found under damp moss in tree-trunks, to belong to it." (Boulenger, 1908.)

*Megalophrys carinensis* (Boulenger)

FIG. 4

*Leptobranchium carinense* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 7, 1889, p. 748 (type locality, western slopes of the Karen Hills, east of Toungoo Burma, elevation 2500 ft.); *ibid.*, vol. 8, 1892-1893, p. 345, pl. 12, (in separate, p. 42); Schlater, Proc. Zool. Soc. London, 1892, p. 347 (vomarine teeth present); Boulenger, The fauna of British India including Ceylon and Burma; Reptilia and Batrachia, 1890, pp. 511-512.

*Megalophrys carinensis* Boulenger, Proc. Zool. Soc. London, 1908, pp. 427-428; Barron, Journ. Nat. Hist. Soc. Siam, vol. 3, no. 1, Nov. 1918, p. 45 (Me Taw a tributary of the Me Wang some miles west of Lakon, Lampang, elev. 700-800 ft.).

*Diagnosis:* A very large pelobatid toad; female with snout-to-vent length of 150 mm.; eyelid with three sharp-pointed flattened tuber-



cles; tympanum hidden; straight diagonal fold from eye to above arm-insertion; arm and leg short; toes about one-third webbed; tongue free posteriorly for half its length, free on sides; vomerine teeth present on two small elevations between choanae but extending behind their posterior level, separated by a distance equivalent to four times length of one; no subarticular tubercles.

*Description of species* (from No. 20 ♀; collected at Chang Kin, Doi Suthep, Chiang Mai, by Oliver Gordon Young): Head extremely flat, wide, length three-fourths of width; snout very short, its length in front of level of eyes, 12 mm.; distance between nostrils, 11 mm.; canthus rostralis sharp; loreal region strongly diagonal; eyelid elevated, projecting, bearing three or more sharp compressed tubercles; total width of eyelid and tubercles contained in inter-orbital distance two and one-half times; depth of head, eleven millimeters at base of snout; depth at occiput 15 mm. Tongue broad, free behind for at least half its length, free on sides; fastened to a triangular thickening in front of tongue; choanae partly concealed by maxillary shelves; vomerine teeth present on two elevations between choanae, their posterior level behind choanal level, separated by a distance nearly four times length of one elevation; palatal glands opening through two circular apertures between choanae, widely separated from each other. Arm rather long in proportion to leg; first finger shorter than second; second and fourth extending forward to same point; legs relatively short, tibiotarsal articulation reaching to back of skull; toes about one-third (or less) webbed; a large flat inner metatarsal tubercle, longer than first toe; no tarsal fold but seemingly a thickened rounded ridge on tarsus; digits with indistinctly widened tips; a more or less distinct ridge on sides of toes; heels fail to meet by a distance of about 13 mm. when legs are folded.

Skin above generally smooth with strong straight fold from edge of eyelid to above arm-insertion; back with pair of curving ridges from head to shoulders; a second pair of elevated dorsolateral ridges and a pair of irregular ridges above groin, with some scattered small ridges and tubercles between, not symmetrically arranged; pair of conical symmetrical tubercles in front of shoulders; two indefinite rows of sharp ridges and tubercles on sides, below which are some flattened tubercles; on upper surface of thigh small light-topped tubercles tending to form transverse rows; tibiae with two or three elongate irregular transverse ridges on black bands; back of thigh with a pair of outer diagonal yellowish spots and a few other more



FIG. 4.—*Megophrys carinensis* (Boulenger). No. 36008. Actual snout-vent length, 124 mm. Kaeng Pang Tao, Chiang Mai, Thailand.



or less symmetrically arranged white spots; a pair of cream glandules on breast, suggesting mammae.

*Color in life:* Top of head smoky fawn; two broad dorsolateral areas of light fawn; area under and back of eye darkened; under-edge of supratympanic fold black from eye to arm-insertion; a dim brownish line follows canthus rostralis; an arched series of small light brownish spots cross between anterior parts of eyes, and a second continuous line crosses between middle of eyelids; two prominent rounded black spots on shoulders; most ridges on back and sides bordered with black, limbs with indistinct darker bands; numerous white punctations on thighs; chin blackish, breast mottled with gray; venter and underside of limbs dirty light brown; palms and soles dark.

*Measurements in mm.:* Snout to vent, 112; width of head, 60; length of head, 45; arm, 59; leg, 130; tibia, 43; tarsus and foot, 60.

*Variation:* Very little significant variation has been noted. The vomerine teeth may be absent (condition in the type), but this condition has not been observed in other specimens.

*Distribution:* This species occurs in the northwestern part of Thailand, especially in Chiang Mai and Lampang provinces. Elsewhere it is known only in Burma and Yunnan, China.

*Remarks:* The species was calling on Doi Suthep, and at Kaeng Pang Tao, 61 km. north of Chiang Mai, during the latter half of June and the first part of July while I was visiting these areas. The call they make can be heard easily at a distance of a quarter of a mile on the Doi. It is introduced on a querulous note followed by a loud raucous call repeated five or six times with slight pauses between. If disturbed by one's presence, the toad may remain quiet for three-quarters of an hour. Ordinarily the call is repeated every ten to fifteen minutes. The animals were usually found ensconced among rocks in a stream, one however, was traced to a perch on the stream's bank. Only four were heard in the two mentioned localities and four were taken. Two other specimens were acquired from Mr. Harold Young and Mr. Oliver Gordon Young. On Doi Suthep they were found at an elevation of 3500 feet; farther north at Kaeng Pang Tao they were taken at an elevation under 500 feet.

The only previous record of this species in Thailand is that of Barron (1918) who obtained a single specimen in Lampang at an elevation of 700 to 800 feet.

*Megophrys feae* (Boulenger)

FIG. 5

*Megalophrys feae* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 4, 1887, p. 512 (type locality, Kakhien Hills, Burma); *ibid.*, vol. 5, 1887, p. 423, pl. 5; Boettger, Ber. Senckenb. Ges., 1888, p. 166; Müller, Verh. Ges. Basel, 1892, p. 200; Boulenger, Proc. Zool. Soc. London, 1908, pp. 411, 428-429; Beddard, *ibid.*, 1911, p. 393 (anatomy); Mell, Arch. Naturg., vol. 88A, 10, 1922, p. 129; Nieden, Das Tierreich, Lief. 46, Anura I, 1923, pp. 63-64, fig. 118 (fig. from Boulenger).

*Leptobrachium feae* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 7, 1889, p. 750; The fauna of British India . . . Reptilia and Batrachia, 1890, pp. 512-513 ("Kakhyen" Hills); Schlater, Proc. Zool. Soc. London, 1892, p. 348.

*Leptobrachium carinense* (not of Boulenger), Boulenger, Ann. Mag. Nat. Hist., ser. 7, vol. 12, 1903, p. 186 (*vide* Boulenger 1908).

*Megophrys feae* Gee and Boring, Peking Nat. Hist. Bull., vol. 4, pt. 2, 1929-1930, pp. 20, 40; Bourret, Annexe au Bull. Inst. Pub., no. 4, 1937, p. 20; *ibid.*, 1939, pp. 43, 45, 46; *ibid.*, 1939, p. 58; Les batraciens de l'Indochine, 1942, p. 218-220.

**Diagnosis:** Very large toads, snout-to-vent measurement 135 mm.; vomerine teeth present. Head very large, depressed, nearly twice as broad as long; snout not projecting beyond lower jaw; canthus rostralis distinct; interorbital distance twice width of upper eyelid; first and second fingers equal; skin with bony deposits on head and anterior part of body; no longitudinal glandular folds. Male with vocal sac. Upper eyelid with a soft dermal projection.

**Description of species** (from Boulenger, 1908): Tongue feebly nicked behind; vomerine teeth usually present in two widely-separated small groups just behind level of choanae; head very large and extremely depressed, once and three fourths to twice as broad as long; snout rounded, hardly as long as eye, not projecting below lower jaw; canthus rostralis distinct; loreal region very oblique, slightly concave; nostril equidistant from eye and from end of snout; interorbital space slightly concave, twice as broad as an upper eyelid; tympanum completely hidden. Fingers short, blunt, first and second equal, two thirds length of third; no subarticular tubercles; metacarpal tubercles indistinct; toes short, blunt, nearly free or with a mere rudiment of a web at base; no subarticular tubercles; a very large flat oval inner metatarsal tubercle. Tibiotarsal articulation reaching axilla, shoulder, or commissure of jaws; tibia one third to two fifths of the snout-to-vent length; foot longer than head.

Skin with bony deposits on head and anterior part of body; a strong transverse fold defines head behind; a strong glandular fold from eye to shoulder; upper eyelid with tubercles, one of which is larger and conical and may be developed into a rather long hornlike appendage in adult. Body and limbs above with scattered small smooth warts; no longitudinal glandular folds; lower parts smooth.

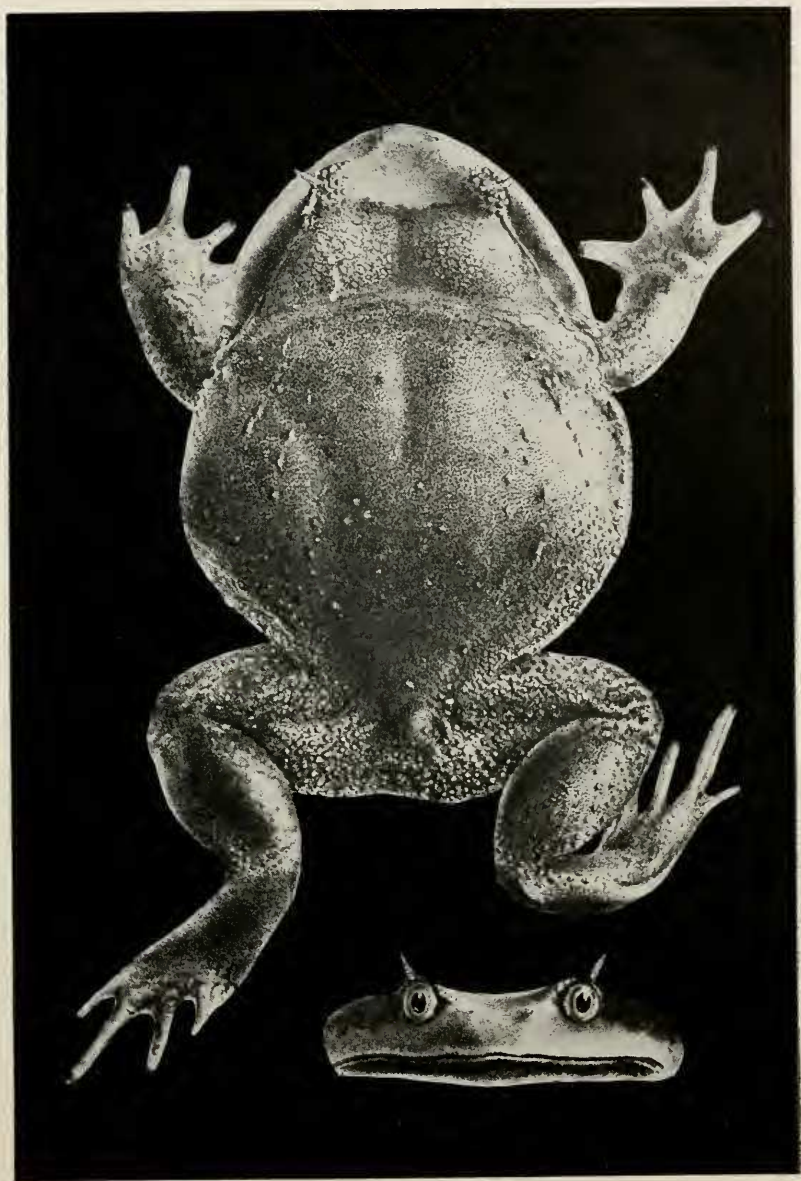


FIG. 5. *Megophrys feae* (Boulenger). After Boulenger (1887) fig. of topotype, snout-vent length, 135 mm.? Kakhien Hills, Burma.

*Color:* Olive-brown above; a T- or Y-shaped darker marking on head, the transverse branch between eyes, often dividing the head into a lighter anterior and a darker posterior portion; a dark temporal band, the lip below it yellowish; lips, eyes, and some of the larger warts on body edged with blackish; some warts whitish; lower parts dirty white to dark brown; throat sometimes spotted dark brown. Male with an internal vocal sac.

*Measurements in mm.:* Sex ♂ and ♀. Snout to vent, 82, 106; length of head (to occiput), 25, 31; width of head, 46, 57; length of snout, 8, 10; diameter of eye, 9, 10; interorbital width, 13, 16; arm, 45, 55; hand, 24, 28; leg, 98, 130; tibia, 31, 39; foot, 31, 41.

*Distribution:* The species is known in northern Burma, and in Viet Nam (Tamdao). It has been reported in Thailand, perhaps incorrectly, but it most probably occurs in the mountains of northern Thailand.

*Remarks:* Boulenger has reported a specimen from the Man Son Mountains as lacking vomerine teeth and with a feebly developed tubercle or "horn" above eyelid. This was obtained at an elevation of from 3000 to 4000 ft.

Bourret (1937, and 1939) reports other specimens from Tonkin and states: "Dents vomériennes habituellement présent."

The following notes were made from a topotypic specimen: The tympanum is completely concealed. There is a slight circular fold across the occiput. On the edge of upper eyelid there is one elongate soft spine and several short tubercles. The skin on dorsum shows two indistinct diagonal rows of small tubercles, discontinuous on sides; a few other scattered tubercles are present. On sides and legs there are also scattered tubercles of varying size.

The vomerine teeth are in two parallel groups directed backwards. The tongue is large (26 mm. x 26 mm.), slightly nicked behind. There is a transverse palatal ridge behind choanae, and another in front of the Eustachian tubes.

The fingers are without subarticular tubercles, the first finger shorter than second, the second and fourth equal. There is a well-defined metacarpal tubercle at base of first finger, and a large one at base of outer finger. A strong inner metatarsal tubercle but no outer, the toes slightly webbed at base. The tibiotarsal articulation reaches the tympanic depression.

The specimen is now violet-lavender with a trace of a dark bar between the eyes. An area about jaw-angle is light colored.



*Megalophrys parva* (Boulenger)

FIG. 6

- Xenophrys monticola* Günther, The reptiles of British India, 1864, p. 414, pl. 26, fig. H (type locality, Sikkim, Himalayas and Khasi Hills. The name already preoccupied by *Megalophrys monticola* Kuhl 1822 for another species).
- Xenophrys monticola* (part.) Anderson, Proc. Zool. Soc. London, 1871, p. 200; Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd Ed., 1882, p. 441.
- Leptobrachium monticola* (part.) Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 7, 1889, p. 720; The fauna of British India . . . Reptilia and Batrachia, 1890, p. 510.
- Leptobrachium parvum* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, p. 344, pl. 9, fig. 2 (type locality, Karin Hills, Upper Burma).
- Megalophrys parva* Annandale, Rec. Ind. Mus., vol. 2, 1908, p. 305; Boulenger, Proc. Zool. Soc. London, 1908, pp. 419-420; ? Annandale, Rec. Ind. Mus., vol. 8, pt. 1, 1912, pp. 28, 29, pl. 4 (tadpole); Nieden, Das Tierreich, Lief. 46, Anura I, 1923, pp. 51, 57; Hora, Journ. Proc. Asiatic Soc. Bengal, vol. 18, 1922, p. 9-15; Rec. Ind. Mus., vol. 30, 1928, p. 139.
- Megalophrys parva* Bourret, Les Batraciens de l'Indochine, 1942, pp. 203-204, fig. 41.

**Diagnosis:** Related to *Megalophrys major* but differing in being much smaller (largest known specimen 54 mm. snout to vent) and in lacking black stripe on side of head and the elongate light mark below it. Toes with only a web-remnant, lacking fringes on sides of toes; fine dorsolateral ridges dim; tongue not notched behind; tip of snout slightly elevated; no spine over eye; eye longer than snout; tympanum distinct, vomerine teeth distinct; tibiotarsal articulation reaches between eye and nostril.

**Description of species** (from No. 35950 ♀): Head short; snout rounded, obliquely truncate, tip turned up slightly at edge; canthus rostralis sharp; loreal region slightly oblique, somewhat concave behind nostril; distinct fold extending back from eye, forming upper border of tympanum, and terminating above arm; tympanum distinct, its diameter about two fifths length of eye, and separated from eye by distance slightly less than its diameter; width of eyelid a little greater than interorbital width.

Tongue rounded posteriorly, not notched, free for about one fifth of its length or less; vomerine teeth on parallel elevations, terminating in two beadlike prominences, beginning at upper level of choanae but the rounded elevation lies chiefly behind choanae; elevations separated from each other by distance slightly less than diameter of swollen area. (Male with vocal sac; vocal slits small, on level with angle of mouth.)

Skin appearing nearly smooth but minutely roughened or corrugated under a lens; sides with few glandular pustules; thigh with four or five very fine transverse irregular ridges; few small glandular



FIG. 6.—*Megophrys parva* (Boulenger). Upper figure, No. 35951 ♂. Actual snout-vent length, 41 mm. Lower figure, No. 35950 ♀, length, 48 mm. Both Doi Suthep, circa 3500 ft., Chiang Mai, Thailand.



pustules about vent; well-defined yellow glandular spot on back of thigh closer to tibia than to vent; a hairfine angular ridge limits interorbital dark mark; a second pair of fine ridges extend back from each eye and meet on middle of back, then separate; a hairfine ridge from a point back of tympanum to lumbar region.

Hand with first finger a little longer than second; a slight swelling on base of first finger but no distinct metacarpal tubercles; no sub-articular tubercles or ridges; a few pustules under forearm; leg slender, tibiotarsal articulation reaching front of eye; toes with mere remnant of web, without lateral ridges or fringes; no subarticular tubercles; no distinct inner or outer metatarsal tubercles; when legs are folded at right angles to body, heels overlap 3.5 millimeters.

*Color:* Dorsum light brown with a light-edged olive triangular mark between eyes; narrow olive-brown marks follow the fine ridges on back; slight olive lines follow ridges on thighs; black marks on hand and fingers; chin and anterior part of venter clouded; two yellow glandular spots on breast; lips barred with olive and dull cream; posterior part of venter and underside of thighs cream with minute powdering of darker pigment; underside of foot and tarsus blackish; black marks on forearm and on sides of tibia.

Measurements in mm. of *Megophrys parva*

Number.....	36582	35950	35951	33610	33611
Sex.....	♀	♀	♂	♂	♂
Snout to vent.....	54	49	40	38	37
Width of head.....	18	18	15	14	13
Length of head.....	19	18	14.5	14.6	13.1
Arm.....	30.5	32	26	23.5	24
Leg.....	80	76	64	59	55
Tibia.....	26	27	20	20	19.5
Foot and tarsus.....	35.5	35	27.5	26.5	23

*Variation:* The largest female (No. 36582) is darker than the specimen here described, and has some small blackish marks on snout, sides, and rump. The side of the head is dark brown, except that the snout-tip has some cream spots. The anterior part of the venter is brownish, while the posterior part and the groin are yellow, as is the underside of the tibia. Underside of the digital tips whitish.

Two males, Nos. 33610, 33611, are dark olive with the side of head, lower side of snout-tip, breast, and the anterior part of venter, blackish. The skin is distinctly more corrugated than in the described specimen and there are some fine dorsal pustules. As regards

the webbing of the toes, and the character of the fine dorsal ridges, they agree well. The males have vocal sacs.

*Distribution:* In Thailand the species has been taken in the province of Chiang Mai. Elsewhere the species has been collected in Sikkim and Burma. In the latter country the range extends far south into Tenasserim.

*Remarks:* Both females examined have ovarian eggs. The described female specimen was taken from a branch in a small shrub about five feet from the ground. She was carrying a clasping male, that would call occasionally. They were about 15 meters from a tiny rivulet.

Without careful examination, this species may be mistaken for the young of *Megophrys major*.

### *Megophrys major* Boulenger

FIGS. 7, 8

*Xenophrys gigas* (non Blyth) Jerdon, Proc. Asiat. Soc. Bengal, 1870, p. 85 (type locality, Darjeeling and Khasi Hills).

*Xenophrys monticola* (part.) Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd Ed., 1882, pp. 441-442.

*Leptobrachium monticola* (part.) Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 7, 1889, p. 720; The fauna of British India, including Ceylon and Burma; Reptilia and Batrachia, 1890, pp. 510-511; Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, p. 343 (Thao, District of Karin Bia-Po, Burma).

*Megalophrys major* Boulenger, Proc. Zool. Soc. London, 1908, pp. 416-417, pl. 23; Annandale, Rec. Ind. Mus., vol. 6, 1911, p. 215; *ibid.*, vol. 8, 1912, p. 29, pl. 4, fig. 9 (tadpole); Nieden, Das Tierreich, Lief. 46, 1923, p. 56, fig. 110 (foot); M. Smith, Proc. Zool. Soc. London, 1926, p. 988; Rec. Ind. Mus., vol. 31, 1929, p. 79.

*Megalophrys longipes* (non Boulenger), Mell, Arch. Naturg., vol. 88, A. 10, 1922, p. 129.

*Megophrys longipes* (non Boulenger), Gee and Boring, Peking Nat. Hist. Bull., vol. 4, 2, 1930, pp. 20, 37, 39.

*Megophrys major* Gee and Boring, Peking Nat. Hist. Bull., vol. 4, 1930, pp. 20, 29; Pope and Boring, *ibid.*, vol. 15, 1940, p. 28; Bourret, Les Batraciens de l'Indochine, 1942, pp. 199-202, fig. 40 (specimen from Mao Son, Tonkin).

*Megophrys longipes maosonensis* Bourret, Annexe au Bull. Inst. Publ. no. 4, 1937, p. 12, fig. 4; *ibid.*, no. 6, 1939, pp. 15, 28; *ibid.*, no. 4, 1939, pp. 45, 46; *ibid.*, no. 4, 1939, p. 58 (type locality Mao Son, Tonkin) (synonymized by Bourret).

*Diagnosis:* A medium-large species (snout to vent, male, 77; female, 94 mm.); vomerine teeth present; interorbital distance equal to or larger than width of an upper eyelid; first finger equal to or a little shorter than second; tibiotarsal articulation to tip of snout. Tongue feebly nicked behind; snout projecting beyond lower jaw; male with vocal sac.

*Description of species* (from No. 36554): Head wider than long



FIG. 7.—*Megophrys major* (Boulenger). No. 36554 ♀. Actual snout-vent length, 91 mm. Doi Pna Kao, near Doi Inthanon, Chiang Mai, Thailand.

(30.5 mm. x 27.5 mm.); interorbital and frontal areas depressed, concave; canthus rostralis distinct, loreal region slightly oblique; concave; nostril equidistant between eye and tip of snout; outline of snout seen from above rather angular, the tip bluntly pointed, extending beyond lower jaw, then sloping backwards and downwards to mouth. Tympanum distinct, oval, its upper portion covered by fold of skin arising from eye and terminating behind jaw-angle; tympanum separated from eye by distance one and a third times the longest diameter of tympanum; interorbital distance slightly greater than width of upper eyelid; tongue not or scarcely nicked or emarginate behind, free for one third of its length; vomerine teeth on two parallel ridges arising behind upper level of choanae; ridges somewhat bulbous posteriorly, separated by a diastema nearly equal to length of one ridge, and from choanae by a similar distance; choanae rather small, concealed when palate is viewed from below; openings of palatal glands on each side of palate at about level of choanae.

Skin generally smooth showing some minute corrugations under a lens; a diagonal fold from eye across upper part of tympanum to above arm-insertion; hair-fine ridges from upper eyelids run back diagonally, meet and continue back on median line some distance; another pair of fine ridges, arising behind eyes, extending diagonally meet and fuse on shoulders; this ridge then extends posteriorly to lumbar region and divides, the branches extending back and outwards, becoming lost on sides. A pair of hair-fine dorsolateral glandular folds from near level of tympanum to groin; some slight ridges across femora and tibiae; lateral skinfold indicated; chin, breast, venter, and underside of limbs smooth; well-defined gland, cream in color on back of thigh, nearer tibia than to vent; similar gland on breast near arm-insertion; irregular row of fine lateral glands, white in color, on side.

Digits of hand widened slightly and swollen at tips; first finger as long as second (left hand) (much smaller abnormally on right); no web or lateral ridges on fingers; flat inner metacarpal tubercle at base of first finger, outer indistinct; no subarticular tubercles; toes flattened, tips widened into small discs without peripheral grooves; toes about one-fourth to one-third webbed, with indication of lateral ridges on some toes; low inconspicuous inner metatarsal tubercle, no outer; no subarticular tubercle; tibiotarsal articulation to nostril or slightly farther; when legs are folded at right angles to body, heels overlap 8 millimeters.



FIG. 8.—*Megophrys major* (Boulenger). No. 36133 ♂. Actual snout-vent length, 65 mm. Doi Suthep, 3000 ft. elev., Chiang Mai, Thailand.

*Color:* Dorsum generally lavender-brown on head, back, and sides; a triangular, dark brown or black-bordered mark between eyelids; sides of head olive-brown; lower eyelid white; an elongate light spot extending below nostril to mouth-angle where it joins the light coloration on sides of neck; lower jaw and chin light brownish-gray with dark-edged cream spots on lip; a dark spot under point of arm-insertion; dark spots under forearm; row of black spots or partly continuous dark line low on sides; strong dark markings at knee and on underside of tibia, tarsus and foot; transverse dark mark with upper sinuous edge across back of thigh enclosing two large cream glandular spots, and numerous cream flecks; side with row of five small white spots; chin and breast brownish gray; underside of thighs and part of underside of tibiae cream-white.

Measurements in mm. of *Megophrys major*

Number.....	36554	36553	33726	36613
Sex.....	♀	♀	♀	juv.
Snout to vent.....	91	87	85	54
Width of head.....	30.5	35	30	20
Length of head.....	27.5	27	25	16
Arm.....	50	44	49	33.5
Leg.....	131	131	132	83
Tibia.....	40	44	43	29
Foot and tarsus.....	59	56	60	36

Number.....	30	46	47	66	36553
Sex.....	♂	♂	♂	♂	♂
Snout to vent.....	76	75.3	79	68	83
Axilla to groin.....	36	36	31	33.1	43
Width of head.....	29	28.5	30	26	31.4
Length of head.....	26	25.3	26	23	26
Arm.....	47	46	44	44	45.4
Leg.....	126	120.4	120	114	126
Tibia.....	45	40	40.2	37	44
Foot and tarsus.....	53.7	50	52	48	56

The males (here measured) from Doi Suthep, (about 3000 ft.) differ from females taken farther north in the character of the feet. In these the digits are distinctly wider and fringed. Also the body is shorter in proportion to the width of the head, than in female specimens listed. At first I suspected I was dealing with a different species. Since each group contains but a single sex I conclude that the differences are sexual. The pattern of coloration and to some extent the ridges on back are similar. Figures are given of both male and female specimens.



Genus *LEPTOBRACHIUM* Tschudi

*Leptobrachium* Tschudi, Classification der Batrachier mit Berücksichtigung der fossilen Thiere dieser Abtheilung der Reptilien, 1839, (1838?), p. 81 (type of the genus *Leptobrachium hasseltii*).

**Diagnosis:** Small pelobatids with vomerine teeth absent; snout not extending beyond lower jaw; tongue broad posteriorly and strongly notched, free behind for a half or more of its length; legs proportionally short; arms slender and proportionally elongate; two well-developed, elevated metacarpal tubercles; vertebrae procoelian; one condyle for articulation with coccyx; omosternum cartilaginous, outer metatarsals united; sternum with a bony style; vocal sac present or absent.

Since Boulenger (1908) found variation in the characters of the vertebrae of *Megophrys* it is not wholly certain that all the presumed generic skeletal characters of *Leptobrachium* listed are invariable. The vocal sac may be absent. How much weight this latter character must be given I cannot say, since the same is true in *Megophrys*.

The following key to the species of Thai *Leptobrachium* will distinguish the various species:

KEY TO THAI SPECIES OF *LEPTOBRACHIUM*

1. Snout angular in profile sloping forward to lip; two very strong metacarpal tubercles subequal in size ..... 2  
     Snout somewhat rounded in lateral profile; metacarpal tubercles strong, inner tubercle several times larger than outer ..... 3
2. A rather large axillary gland; one or two glands on posterior face of femur; no gland on breast; sides and venter white, speckled with small subequal black spots; back without spots, venter not granular ..... *hendricksoni*  
     A smaller axillary gland, ocellate; ventral surface of chin and venter granular or areolate; gland on back of femur diffuse or indistinct; venter reticulated with blackish brown; back with rather large numerous irregular spots, more or less distinct ..... *hasseltii hasseltii*
3. Tympanum moderately distinct; a conspicuous gland above insertion of arm, one on breast near insertion of arm, and one on posterior face of femur. Scattered tiny glandules on sides ..... *pelodytoides*  
     Tympanum larger, round, very distinct; no gland above arm-insertion; a ventrolateral gland or glandular fold extending more than half way between axilla and groin; a white gland and a large blackish area on back face of femur ..... *minimum*

*Leptobrachium hendricksoni* sp. nov.

FIGS. 9, 10

*Type:* No. 34749, collected, Bhetong, Yala, Thailand, Jan. 26, 1957, by Edward H. Taylor.

*Paratypes:* Nos. M.198, M.199, Kuala Tahan, King George V Nat. Park, Pahang, Malaya, Mar. 23, 1956, Dr. J. R. Hendrickson, collector, Mar. 12, 1957.

*Diagnosis:* A medium species, known maximum size, 63 mm., snout-to-vent length; head broader than body; tongue ample with a V-shaped notch behind, free posteriorly for half its length, free on sides. Male with vocal sac, the slits opening far back near jaw-angle; no vomerine teeth; choanae entirely visible from below; first finger equal or slightly longer than second; unicolor lavender brown above; venter, chin, side, groin, and limbs speckled with small black spots, the largest ones on legs.

*Description of type:* Head broad; very sharp canthus rostralis; loreal region oblique, shallowly concave; nostrils just below level of canthus, the area about them swollen, with slight depression between swollen areas, snout sloping obliquely forward to lip in front of them; distance of nostril from eye (6 mm.) equal to its distance from median point on upper lip (6 mm.); length of eye (8.5 mm.) a little shorter than length of snout (9.5 mm.); tympanum very distinct, its greatest (diagonal) diameter (5 mm.), greater than its distance from eye (3 mm.); a sharp skinfold from eye curves down behind tympanum and stops just behind jaw-angle; interorbital distance (9 mm.) wider than upper eyelid, (6.2 mm.).

Tongue broad with a V-shaped notch behind, its width (19 mm.) less than length (23 mm.), free behind for half its length, free on sides, considerably narrowed anteriorly at attachment (6 mm.); choanae clearly visible from below, somewhat angular; just anterior to their forward level, a pair of subtriangular pits marking openings of palatal glands; openings of Eustachian tubes equally as large or larger than choanae, no dermal fold between them.

Arm elongate, slender; more than half of forearm extends beyond tip of snout when laid forward; first finger a little longer than second, fifth minutely longer than second; no trace of web, but lateral ridges on some fingers; no subarticular tubercles, but fingers with some elongate callous ridges; a pair of very strongly developed elevated metacarpal tubercles. Legs relatively short, tibiotarsal articulation reaching to tympanum when legs are stretched forward; when legs are folded at right angles to body, heels separated by a distance of



FIG. 9.—*Leptobrachium hendricksoni* sp. nov. No. 34749 ♀. Actual snout-vent length, 63 mm. Bhetong, Yala, Thailand.

four millimeters; distinct web between toes, four joints of fourth toe free; three inner digits with lateral ridges; distinct elongate callous ridges under second, third, and fourth toes; a distinct inner metatarsal tubercle, its length half its distance from tip of first toe; no outer tubercle or tarsal fold; tips of all digits slightly swollen, but bluntly pointed.

Skin generally smooth above with fine indistinct veinlike reticulation; a little less smooth low on sides, with indistinct tuberculation evident; chin and breast smooth; posterior part of venter with indistinct flat tubercles; pair of larger postfemoral glands nearer insertion of tibia than vent; between these and vent a smaller pair; a well-defined pair of axillary glands.

*Color:* Above lavender brown on head, back, upper part of femur, tibia, and arms; very indistinct, darker-edged mark between eyes and lighter vertical dark-edged mark on tip of snout; black line below canthus, and narrow black line curving under eye; narrow black line follows supratympanic fold; tympanum brownish black; groin area, front and back of femur, concealed parts of tibia, and upper part of foot and tarsus speckled with black; chin breast, venter, and underside of arms finely speckled with black on cream to gray-white ground color; chin and posterior part of venter dusted with fine pigment; grayish behind and below vent; tips of digits cream.

Measurements in mm. of *Leptobrachium hendricksoni*

Number.....	34749	M198	M199
Sex.....	♀	♂	♂
Snout to vent.....	63	46	45
Width of head.....	27	14	15
Length of head.....	26	20	19
Arm.....	40.5	33	34
Leg.....	69	56	53
Tibia.....	23	16.5	17
Foot and tarsus.....	31	23	14.4

*Variation:* The males have the head markings partly absent, or very indefinite. In one specimen the first finger appears to be scarcely equal to second. The larger postfemoral glands are present on both males; both however, lack the inner smaller pair as described in the female.



FIG. 10.—*Leptobrachium hendricksoni* sp. nov. Tadpole. No. 34739A. Actual snout-vent length, 49 mm. Kuala Lumpur, Malaya.

*Distribution:* This species is known from the type locality in Thailand. In Malaya the species has been taken in King George V Park, Pahang, Malaya, and at Kuala Lumpur and environs.

I have seen many of the easily recognized larvae taken by Dr. Hendrickson and myself on the campus of the University at Kuala Lumpur.

*Remarks:* The tadpoles of this form are being studied by Dr. Hendrickson. It is quite probable that in the past this species has

been mistaken for *Leptobrachium hasseltii* which also occurs in Malaya and Thailand.

*Leptobrachium hasseltii hasseltii* (Müller in Tschudi)

FIGS. 11, 12, 13

*Leptobrachium hasseltii* Müller, in Tschudi, Classification der Batrachier . . . 1838, p. 81 (attributed to Müller M. S.; type locality, Java); Boulenger, Catalogue of the Batrachia Sientia s. Ecaudata in the British Museum, 1882, p. 441; The fauna of British India, including Ceylon and Burma; Reptilia and Batrachia, 1890, p. 511; Proc. Zool. Soc. London, 1890, p. 37; Butler, Journ. Nat. Hist. Soc. Bombay, vol. 15, 1904, p. 397.

*Megalophrys hasseltii* van Kampen, Natuurk. Tidsch. Ned. Ind., vol. 69, 1909, p. 27, pl. 2; Boulenger, Proc. Zool. Soc. London, 1908, p. 425, pl. 25, fig. 3; A vertebrate fauna of the Malay Peninsula, from the Isthmus of Kra to Singapore including the adjacent islands; Reptilia and Batrachia, 1912, pp. 282-283; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 2, Dec. 1916, pp. 170-171; Ammandale, Mem. Asiat. Soc. Bengal, vol. 6, 1917, p. 153, pl. 6; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 3, May, 1917, p. 23 (Hill country of peninsular, western, and northern Thailand); *ibid.*, no. 4, Dec. 1917, p. 274; Taylor, Proc. Acad. Nat. Sci. Philadelphia, vol. 86, June 13, 1934, p. 287 (Chiang Mai). Taylor, Phil. Journ. Sci., vol. 21, 1922, pp. 184-185, pl. 4, fig. 1.

*Megophrys hasselti hasselti* Bourret, Les Batraciens de l'Indochine, 1942, pp. 211-213; Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, Mar. 20, 1958, pp. 1077-1079, fig. 14 (photograph), (Na Haeo, Dan Sai, Loei Province).

*Diagnosis:* Head as wide or wider than body, one to one and one-fifth times as wide as long; canthus rostralis sharp; arms proportionally long, legs weak, slender; tibiotarsal articulation reaching between shoulder and eye; no palpebral appendages or spines; no vomerine teeth; male with a vocal sac; inner metatarsal tubercle present, no outer.

*Description of species* (from EHT-HMS No. 31762 Na Haeo, Loei Province): Head about as wide as long; canthus sharply defined; loreal region oblique, concave; snout in front of nostrils sloping obliquely; interorbital width once and three fourths width of an eyelid; tympanum small, its diameter less than half length of eye-opening, upper part covered by a sinuous fold from eye to angle of jaw. Eyes prominent.

Posterior two thirds of tongue free, notched behind; two large slitlike openings to vocal sac far back near mouth-angle; choanae large; no vomerine teeth; two distinct openings to palatal glands lying between inner level of choanae, but slightly in advance of choanae.

Skin on dorsum minutely granular or pustular, pustules larger and more prominent on sides; chin with small granules; entire venter with larger granules or areolations; underside of thighs smooth ex-





FIG. 11.—*Leptobrachium hasseltii* Müller in Tschudi. EHT-HMS No. 31762 ♂, Na Haeo, Loei, Thailand. Actual snout-vent length, 46 mm.

cept for a few proximal granules; few granules about vent; more or less distinct fold on each side, anteriorly touching, but not continuous with, the supratympanic fold.

Arm slender; first finger a little longer than second; latter longer than fourth, third double length of second; digits with terminal discs not wider than digits; undersurface of digits with some broken elongate callous ridges that may incorporate any subarticular tubercles that may be present; inner fingers and inner edge of outer fingers with narrow lateral fringe or ridge, but no web; two very prominent metacarpal tubercles; toes short, one-third to one-half



FIG. 12.—?*Leptobrachium hasseltii* Müller in Tschudi. EHT-HMS No. M200. Actual snout-vent length, 44 mm. Singapore Island.



FIG. 13.—*Leptobrachium hasseltii* Müller in Tschudi. Upper figure No. 36609. Actual snout-vent length, 49 mm. Lower figure, No. 36605, length, 54 mm. Both from Whe Tat Village, Chiang Dao, Chiang Mai, Thailand.

webbed on inner toes, but web continued as a fringe or ridge to the terminal digital swelling; a well-defined inner metatarsal tubercle; no outer tubercle; no tarsal fold or ridge; when legs are folded at right angles to body heels fail to meet; an elongate ridge on underside of third and fourth toes, barely indicated on second; tibiotarsal articulation reaches to near tympanum.

*Color:* Above lavender with darker lavender or purplish; numerous darker irregular blotches or spots on dorsum and sides; a dark longitudinal interorbital line joining a transverse interorbital mark; loreal region and lip with three or four black spots; a dark line from nostril to eye, and from eye along supratympanic fold, widening on tympanum; arms and legs banded dark lavender above; venter and chin yellowish with clouding of lavender, or numerous flecks of brown or lavender tending to touch each other and forming a reticulation.

Measurements in mm. of *Leptobrachium hasseltii hasseltii*

Number.....	36606	36605	36608	36609	36607	31762
Sex.....	♂	♂	♂	♂	♂	♂
Snout to vent.....	56	56	51	50	48	46
Head width.....	27	27	24	22.7	21.5	21.5
Head length.....	21.5	21	19	18	17	21.5
Arm.....	37	37	30.5	31	30.5	29
Leg to vent.....	61	60	54	52	53	49
Tibia.....	20	19	17.2	16.6	16	16.5
Foot and tarsus.....	28	27	25	23.5	24	22

*Variation:* The populations now included in the species *L. hasseltii* show very considerable variation. The range is great, the species occurring in Borneo, Sumatra, Burma, Thailand, Tonkin, and Hainan. Two subspecific forms have been designated. These are *hasseltii pullus* by Malcolm Smith (1921, p. 440); and *hasseltii chapaensis* by Bourret (1937, p. 18, fig. 6) both from Indo China. The population from northwestern Siam probably merits subspecific designation. Another form occurring in Thailand and illustrated here may or may not be typical of the Javan (type) form as I have designated it. Until some worker can review material from this very great range and directly compare it with the Javan form, relationships of the various populations will be uncertain. The three specimens illustrated give some indication of differences, especially in the shape of the head and body.

*Distribution:* In Thailand specimens are known from Chiang Mai, Loei, Trang, and Chumphon provinces.

*Leptobrachium pelodytoides* Boulenger

FIG. 14

*Leptobrachium pelodytoides* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, pl. 11, fig. 3 (type locality, Karin Hills, east of Toungoo, Burma, at Thao and Karin Bia-Po); Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903 (1904?), p. 397 (Perak).

*Megalophrys pelodytoides* Boulenger, Proc. Zool. Soc. London, 1908, pp. 423-424; A vertebrate fauna of the Malay Peninsula, . . . Reptilia and Batrachia, 1912, p. 282; M. Smith, Journ. Nat. Hist. Soc. Siam, II, 1917, p. 272, fig. (tadpole); Nieden, Das Tierreich, Lief. 46, Anura I, 1923, pp. 60-61.

*Megophrys pelodytoides* M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 133; Pope, Bull. Amer. Mus. Nat. Hist., vol. 61, 1931, pp. 447-450, fig. 4; Boring, Mem. B. A. China Rept., 1932, p. 102; Bourret, Annexe au Bull. Inst. Publ., no. 4, 1937, p. 17; Pope and Boring, Peking Nat. Hist. Bull., vol. 15, 1940, p. 30; Bourret, Les Batraciens de l'Indochine, 1942, pp. 208-211, fig. 45.

**Diagnosis:** A small species (snout-to-vent length, 54 mm., ♀), snout not projecting beyond lower jaw; two metacarpal tubercles, inner large, outer smaller; tibiotarsal articulation reaches to between eye and nostril; vomerine teeth absent; tongue strongly notched behind; first and second fingers equal; toes of males one-third to one-fourth webbed; a subgular vocal sac; no fine dorsal ridges.

**Description of species** (from cotype, Genova, No. 27845B): Head moderate, about as long as wide; snout rounded, scarcely projecting beyond lower jaw, a little shorter than length of eye; canthus rostralis distinct, curving inwards somewhat, loreal region oblique and distinctly concave; nostril distinctly closer to eye than to mid-point on upper lip; interorbital distance equivalent to width of an upper eyelid; tympanum moderately distinct, its greatest diameter a little more than half length of eye, separated from eye by a distance slightly less than its own diameter; a distinct fold from eye to above arm-insertion.

Vomerine teeth absent; when palate is viewed from below choanae not concealed by palatal shelf; tongue large (12 mm. x 9 mm.), strongly nicked behind, free behind for two fifths of its length; two strongly defined somewhat circular openings for palatal glands, lying between anterior edges of choanae or a little farther forward.

Fingers slightly swollen at tips, first a little shorter than second (equal in type description); second and fourth fingers about equal; very strongly defined inner metacarpal tubercle, and distinct outer, much smaller than inner. No subarticular tubercles; leg moderate, tibiotarsal articulation reaching to eye; when legs are folded at right angles to body, heels fail to touch by a distance of two or three millimeters; no subarticular tubercles, but elongate callous areas





FIG. 14.—*Leptobrachium pelodytoides* Boulenger. Paratype, Mus. Civ. Genova, No. 27845B. Actual snout-vent length, 30 mm. Karin Bia-Po, Burma.

under toes; a small distinct inner metatarsal tubercle; digits somewhat widened at tips, lacking or with only trace of web, and indications of lateral ridges on sides of inner fingers. No tarsal fold.

Skin smooth above with small smooth pustules, more distinct laterally; ventral surfaces of body and limbs smooth except for fine indistinct granules on chin; a pair of small light-colored glands on breast near point on insertion of arm; gland on back of femur, closer to tibia than to vent; gland on side of rump above groin; sides with several small whitish glands.

*Color:* Olive above with some darker spots or marbling on head, dorsum, and sides; dark marks between eyes preceded by a lighter bar and this bordered anteriorly by another darker bar; upper lip with some dark vertical bars, or posteriorly, diffuse spots or clouding; arms, legs, and foot, strongly barred with dark brown; whitish on venter, the brown color on sides encroaching on venter, while most of surface is dusted with cinnamon pigment; on chin, very numerous tiny whitish flecks.

*Measurements in mm.* (two cotypes): Snout to vent, 30, 37; length of head, (to occiput), 10, 13; width of head, 10, 15; length of snout, 3.5, 4.6; diameter of eye, 3.5, 4.3; interorbital width, 3, 4; diameter of tympanum, 2, 2; distance between eye and tympanum, 1.5, 1.8; arm, 19, 23; hand, 8, 10; leg, 46, 51; tibia, 15, 16.3; foot, 15, 21.

*Distribution:* *Megophrys pelodytoides* has been reported from Doi Nga Chang, N. Siam by Malcolm Smith who states: "Not uncommon above 1000 meters." It is known from Burma, the type locality being the Karin Hills. Boulenger (1908) has referred to this species a series of specimens and states that they differ from the types in having less web between the toes (only a rudiment in the female, and none of the males has the toes more than one-fourth webbed).

*Variation:* It may be noted that the cotype specimen I have here described has the web reduced to a mere remnant. Boulenger's specimens from Tonkin averaged larger, the females reaching a size of 42 millimeters. Malcolm Smith obtained tadpoles which he referred to this species. They measured 60 mm. total length, and 21 mm. snout to vent length.

*Leptobrachium minimum* sp. nov.

FIG. 15

*Type:* No. 34020, Doi Suthep, *circa* 1000 m. elevation Chiang Mai, Chiang Mai province, Thailand; Edward H. Taylor, coll., Dec. 21, 1957.

*Paratypes:* Nos. 22 and 35980, topotypes, same collector.

*Diagnosis:* Tongue oval, nicked behind; no vomerine teeth; canthus rostralis angular; toes with remnant of web; two metacarpal tubercles, inner very large, outer smaller; no subarticular tubercles on hand; first finger shorter than second; on foot subarticular tubercles present only under second and third toes; a small yellow ventrolateral glandular ridge or fold; a yellow gland above arm-insertion and one on breast in front of arm-insertion, an elongate black spot under thighs with a white or cream gland on its posterior



FIG. 15.—*Leptobrachium minimum* sp. nov. No. 34020 ♂. Actual snout-vent length, 27 mm. Doi Suthep, Chiang Mai, Thailand.

edge; an inner but no outer metatarsal tubercle; black spots on sides and in groin. Maximum length, 29 mm.

*Description of type:* Snout short, canthus rostralis rounded; nostril slightly nearer eye than to tip of snout; snout projecting two millimeters beyond mouth; distance between nostrils about equivalent to interorbital distance; tympanum distinct, its diameter slightly more than half diameter of eye; a strong curving fold above tympanum, terminating at a gland above arm insertion.

Tongue notched behind, free on sides and for two thirds of its length; no vomerine teeth; choanae nearly lateral. Two small vocal sacs, the openings small, puckered, behind mouth-angle. Arm rather short; a pair of small glands on breast near arm-insertion; first and second fingers of about equal length; a very large inner metacarpal tubercle and a smaller outer tubercle; four small tubercles under forearm in a longitudinal row; fingers (and toes) without subarticular tubercles, their tips truncate, slightly enlarged; toes with a web-remnant at base, having a ridge or fringe on lateral edges of toes continued to near tip; tips slightly enlarged; a strong inner metatarsal tubercle but no outer; no trace of a tarsal fold; when legs are folded at right angles to body, heels touch; tibiotarsal articulation reaching eye; pupil vertically elliptic, appearing almost round.

Skin rather smooth, with very small or microscopic rugosities and tubercles; a row of widely spaced tubercles above thigh, tibia, and tarsus; chin and venter smooth; anterior part of thigh smooth, posterior part granular, bearing on posterior surface a round cream-colored gland; several symmetrically placed glandular tubercles in anal region.

*Color in life:* Above generally olive-brown on head and body; side of head dull cream with two dim darker spots on upper lip; tympanum brown; supratympanic fold blackish; sides cream with several black spots on sides and smaller black flecks in ventrolateral regions; a salmon glandular spot above arm-insertion; forearm with two dark transverse bands; a cream lateral fold, or row of glandules, moderately distinct; thigh with two or three transverse dark bands above; posterior part of tibia with three transverse dark bands on ventral side, separated by cream; black spots under tarsus; a large black area under thigh, extending up somewhat on posterior surface; a prominent glandular cream spot, surrounded by black, on distal part of posterior surface of thigh; black under heel and tarsus, the sole lighter.

Measurements in mm. of *Leptobrachium minimum* sp. nov.

Number.....	22	34020	35980
Sex.....	♂	♂	♂
Snout to vent.....	23	27	28.6
Width of head.....	9.4	11	11
Length of head.....	8.2	11.8	10
Arm.....	16	18	18.5
Leg.....	37	38	43
Tibia.....	13	12	14
Foot and tarsus.....	16	18.5	19.3

*Distribution:* Known only from the type locality.

*Remarks:* The type specimen was found in a small mountain stream on Doi Suthep, near Chiang Mai, at an elevation of about 900 meters, in 1957. Several were seen but only one was taken on my first visit. They were hidden among groups of small rocks surrounded by water. When disturbed they were especially active, escaping as soon as the rocks were moved, diving into the fast-moving water under which they would conceal themselves for a short time, then regain the opposite bank.

Two specimens were taken in late September, 1958, when I paid a second visit to the mountain. These were found in a similar habitat at an elevation of about 1090 m. In 1959 a fourth specimen was taken near the type locality.

This species would seem to be close to *Leptobrachium oshanensis*, a Chinese species, which appears to differ chiefly in having a single, rather than paired, vocal sacs; and in lacking an elongate ventrolateral gland. The coloration also is different.

#### FAMILY BUFONIDAE

This family of amphibians is nearly world-wide in distribution in temperate and tropical zones, some species even penetrating into the arctic zone. It is, however, absent on the great island, Madagascar.

Southeastern Asia and the Archipelago have representatives of six bufonid genera: *Bufo*, *Ansonia*, *Pseudobufo*, *Ophryophryne*, *Pelophryne*, and *Pedostibes*. In Thailand only three of these are represented, *Bufo* by four species; *Ansonia* and *Pedostibes*, each represented by a single known species. One other genus, *Pelophryne* should be looked for in the southern part of peninsular Thailand, since *Pelophryne guentheri* occurs in nearby Malaya. It is a small

species living along mountain streams and may be easily overlooked.

The species most frequently seen in Thailand is the ubiquitous and widespread *Bufo melanostictus*. It might well be regarded as a domestic species, since it is to be found in and about dwelling places throughout the country. It hides usually during the day, emerging at night to forage on insects attracted by lights. In cities one may often find it moving about on the ground under electric lights.

Breeding choruses are well known in the klongs and ponds of the city of Bangkok. Choruses that begin at night may often continue through the following day. Some lively stories dealing with "battles between large and small frogs" have appeared in Thai newspapers written by reporters who have lacked training in Zoology and who have misinterpreted the observations made. The small frogs are the males, the large ones females and what appears to be battle is the attempt of one or more males to clasp the females.

### Genus BUFO Laurenti

*Bufo* Laurenti, Specimen medicum, exhibens synopsis reptilium emendatum cum experimentis circa venena et antidota reptilium austriacorum Viennae 1768, p. 25 (type of genus *Rana bufo* Linnaeus).

**Diagnosis:** Tongue oval, elliptic not notched, free behind; no vomerine or maxillary teeth. Tympanum distinct or hidden by skin, rarely absent; web absent on fingers; toes usually with a thickened web and not on but slightly widened digit-tip. Outer metatarsal united; usually only a single slit enters vocal sac; omosternum usually absent, but of cartilage where present; a cartilaginous or bony sternum. Pupil horizontal; parotoid gland present and conspicuous.

These are the animals commonly known as toads. They have a distribution that is cosmopolitan extending near to if not reaching the Arctic Zone in Alaska. They are present on Madagascar but absent in Australia. They are omnipresent in Thailand.

### KEY TO THE THAI GENERA OF BUFONIDAE

1. No parotoids present; cranial crests absent; webs between digits membranous ..... *Ansonia*
- Parotoids present, cranial crests present or absent, webs usually thickened ..... 2
2. Fingers partly, toes almost completely webbed; tips of digits widened into discs; arms and legs longer ..... *Pedostibes*
- Fingers unwebbed, tips not distinctly widened; body with numerous spiny tubercles and warts; arms and legs shorter ..... *Bufo*



## KEY TO SPECIES OF BUFO IN THAILAND

1. Cranial crests or ridges absent; parotoid glands low; diameter of tympanum equal to length of eye or slightly less; snout to vent 55 mm.,  
*macrotis*  
Cranial crests or ridges present; parotoid glands distinct, elevated; tympanum variable . . . . . 2
2. Crests when present sharply distinct, variable in number; web on foot not reaching digital tips; large or small . . . . . 3  
Ridges or flat crests on head often rather indistinct; web on foot reaching discs on toes; diameter of tympanum about one third length of eye. Very large toads, snout to vent 215 mm. . . . . *asper*
3. Small toads, supraorbital and parietal crests continuous, forming curves extending to or near back of occiput; diameter of tympanum two thirds to three fourths length of eye. Snout to vent, 50 mm. . . . . *parvus*  
Large toads with a full set of cranial crests except parietal (rarely indicated), the crests covered with black horn; snout to vent, 97 mm.; diameter of tympanum about two thirds of length of eye,  
*melanostictus*

*Bufo macrotis* Boulenger

FIG. 16

*Bufo macrotis* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 5, 1887, pp. 422-423, pl. 4, fig. 3 (type locality, Kakhien Hills, Burma); *ibid.*, vol. 13, 1892-1893, p. 40 (Palon, Burma); The fauna of British India . . . Reptilia and Batrachia, 1890, pp. 502-503; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 2, Dec. 1916, pp. 169-170; *ibid.*, vol. 2, no. 3, May 1917, p. 230 (Krabin, eastern Siam; Sai Yoke, Kanchanaburi province, western Siam; Pattani, Pattani province, southern Siam); Barron, *ibid.*, vol. 3, no. 3, Aug. 1919, p. 230; Nieden, Das Tierreich, Anura I, Lief. 46, 1923, p. 88, fig. 158; M. Smith, Bull. Raffles Mus., no. 3, Apr. 1930, p. 30 (Muang Sai, Pattani); Cochran, Proc. U. S. Nat. Mus., vol. 77, 1930, p. 8 (Nong Ri, Nakhon Nayok province).

*Diagnosis:* Head lacking crests; parotoid glands low, little larger than eyelid; tympanum large, equal to or little less than eye; body covered with very numerous tubercles of varying sizes, those on head smallest; no tarsal fold but row of larger tubercles on tarsus; distinct inner and a smaller outer metatarsal tubercle; large rounded palmar tubercle; first finger longer than second; subarticular tubercles on hand often bifid or trifid.

*Description of species* (from No. 36564 collected by Gordon Young, on top of Doi Hkram, Mong Haut, Chiang Mai, at an elevation of about 7000 ft.): Head rather flat, eyes elevated slightly; no cranial crests; parotoid glands flat (approximately 6.5 by 6.5 mm.); tympanum large, clearly defined, almost size of eye; tongue narrow, elongate, free for four fifths of its length; seen directly from below only inner edges of choanae are visible.

Arm moderate, first finger longer than second; large rounded

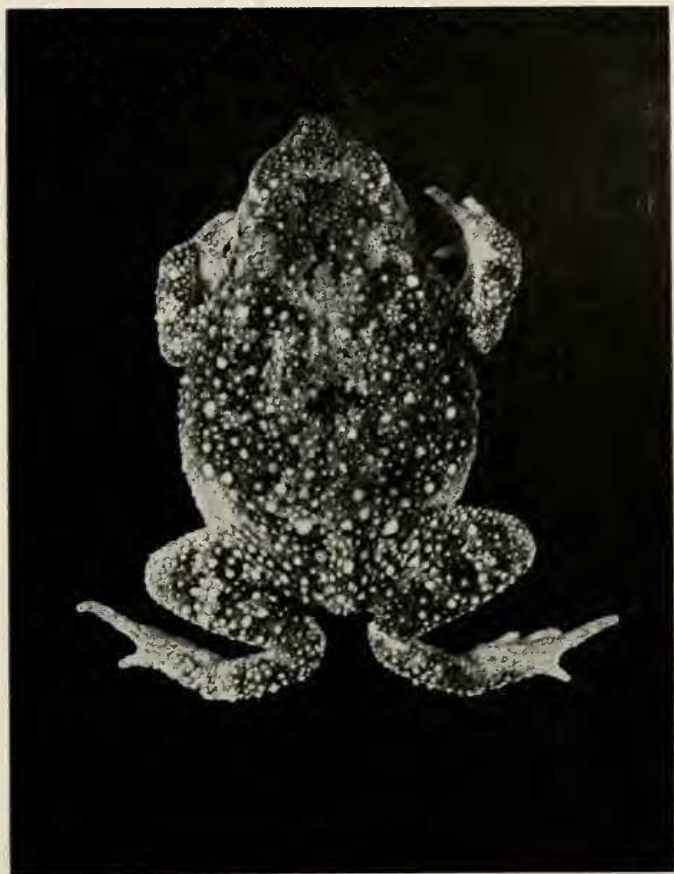


FIG. 16.—*Bufo macrotis* Boulenger. No. 36564. Actual snout-vent length, 55 mm. Doi Hkram "approx. 7000 ft." Chiang Mai, Thailand.

palmar tubercle; subarticular tubercles bifid (or trifid) with a row of enlarged tubercles from wrist to elbow; leg rather short, tibio-tarsal articulation reaching tympanum. An elevated oval inner metatarsal tubercle and a small outer tubercle; small web between toes; no tarsal fold, but an inner and an outer row of enlarged tubercles; when legs are folded at right angles to body heels fail to meet. Entire body covered with tubercles or warts of varying size, often spiny; few enlarged tubercles at sides of vent.

*Color:* Above light brown with more or less symmetrical darker areas on snout and between eyes; a  $\Delta$ -shaped mark in front of shoulders and dark spot near middle of back; sides dark, mottled; limbs

with indefinite dark marks; tympanum uniformly dark; edge of upper lip white. Venter, chin, and concealed parts of limbs dirty yellowish-white. Dorsal tubercles on body cream; tubercles on limbs and subarticular tubercles cream to yellow.

*Measurements in mm.*: Snout to vent, 55; snout to arm-insertion, 20; axilla to groin, 26; width of head, 20; length of head, 18.2; arm, 34; leg (from vent), 66; tibia, 20; foot and tarsus, 29.

*Distribution*: The species has been taken in western Thailand in the provinces of Chiang Mai, Nakhon Nayok, Kanchanaburi, and Pattani. Elsewhere it is known in Burma.

*Remarks*: Barron, *loc. cit.* has given an account of the breeding of this toad in July and August. He states:—"when the skin of the male becomes smooth and changes from dark brown to quite a bright yellow color, the female retains her normal characteristics. They are to be found in large numbers in pools in or near small forest streams, the males invariably preponderating" . . . "if the males are separated from the females they very soon resume their normal coloring, but although I kept them for several days their skin did not become warty, as it is out of the breeding season."

This change during the breeding season in the characteristic of the skin (*i. e.*, the loss of the warty tubercles) is not usual in toads! Sometimes they are known to be less conspicuous in gravid females distended with eggs.

### *Bufo asper* Gravenhorst

FIG. 17

*Bufo asper* Gravenhorst, Deliciae Musei Zoologici Vratislaviensis continens Chelonios et Batrachia, fasc. 1, Lipsiae, 1829, p. 58 (type locality, Java); Schlegel, Abbildungen . . . Amphibia, 1837-44, p. 63, pl. 20, fig. 1; Günther, The reptiles of British India, 1864, p. 423; Stoliczka, Journ. Asiat. Soc. Bengal, 1873, p. 113; Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum (Natural History), 1882, p. 313; The fauna of British India . . . Reptilia and Batrachia, 1890, p. 507; Flower, Proc. Zool. Soc. London, 1896, p. 912, pl. 44, fig. 3; *ibid.*, 1899, p. 910; Laidlaw, Proc. Zool. Soc. London, 1900, p. 888; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1904, pp. 396-397; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 271-272; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 3, May, 1917, p. 230 peninsular and western Siam); Journ. Federated Malay States Mus., vol. 10, 1922, p. 282; van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, pp. 82-84; Nieden, Das Tierreich, Lief. 46, Anura I, 1923, p. 119, fig. 168; Cochran, Proc. U. S. Nat. Mus., vol. 77, 1930, p. 8 (Nakhon Si Thammarat); M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 131 (Tasan, Isthmus of Kra; Nakhon Si Thammarat Mountains); Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, Mar. 20, 1958, pp. 1075-1076, fig. 13.

*Phrynoidis asper* Fitzinger, Systema Reptilium, vol. 1, 1843, p. 32.

*Nectes obscurus* Barbour, Proc. Biol. Soc. Washington, vol. 17, 1904, p. 51 (type locality, Sarawak).

*Bufo obscurus* Barbour, Mem. Mus. Comp. Zool. Harvard College, vol. 44, no. 1, 1912, p. 75, pl. 6, fig. 20.

*Diagnosis:* Very large toads without parietal crests; orbital ridges flattened, indistinct; canthal ridges distinct in younger specimens; supratympanic ridge strong, thickened, touching small distinct parotoid gland; fingers free, toes about three-fourths webbed,\* webs touching discs on outer side of three inner fingers and inner side of fifth; two distal joints of fourth toe free; a strong tarsal fold; digital tips swollen, somewhat widened; two metacarpal tubercles, outer largest; two metatarsal tubercles, inner largest; tibiotarsal articulation reaches to tympanum or eye; tympanum small, its diameter about one third that of eye.

*Description of species* (from No. 152 Na Bon, Nakhon Si Thammarat): Head relatively narrow; canthus rostralis distinct, angular, loreal region practically vertical, not or scarcely concave; nostrils lateral; tip of snout obliquely truncate; eyes prominent, edge of upper eyelid thickened; canthal crests distinct with depression between them; orbital crests flat, widened, not continuous with canthal crest; postorbital or parietal crest not evident; very strong, widened supratympanic crest touching upper eyelid and parotoid gland; latter small, slightly diagonal, somewhat longer than wide; width of an eyelid distinctly less than distance between orbital crests; interorbital region concave; length of eye about equal to length of snout. Tympanum about one third diameter of eye.

Choanae strongly narrowed, followed behind by a high bony ridge; tongue broadly oval, free behind for two thirds of its length; (males with a pair of vocal slits back near angles of jaws).

Skin of entire surface covered with larger and smaller warts and granules; dorsum with numerous large warts rounded or flattened; larger warts on legs pyramidal, surmounted by one or more small spines; granules vary in size on chin, breast, venter, and underside of limbs, smaller than dorsal warts, each with small central spine and with very numerous minute spines; tarsal fold nearly straight, its edge surmounted by brown tubercles; (first finger of males with an area covered with minute horny nuptial spines that extends nearly to tip on inner side; horny spines also present on second finger); first finger not or but very little longer than second (many specimens have them same length); inner edge of first three fingers and outer edge of fourth with a longitudinal ridge or fold; subarticular tubercles single, well developed on hand and foot; web on toes reaches

\* Boulenger (1912, p. 272), says, "toes completely webbed." I have seen no specimens in this condition. A specimen from Kuala Lumpur agrees with the specimens from southern Thailand.



FIG. 17.—*Bufo asper* Gravenhorst. No. 34541. Actual snout-vent length, 152; Bhetong, Yala, Thailand.



discs of three inner toes on their outer side, and fifth toe on its inner side; elsewhere web may form a narrow fringe or ridge that reaches disc except on fourth toe which has two distal joints free.

The tibiotarsal articulation reaches to posterior edge of eye; when legs are folded at right angles to body, heels very narrowly separated.

*Color:* Above light olive to olive-brown nearly uniform; venter brownish white with indistinct darker spotting or mottling.

*Measurements in mm.* (No. 152, 1573 [Bhetong, Yala Province], respectively): Snout to vent, 137, 110; width of head, 50, 40; length of head, 38, 29; eye length, 15, 11; length of snout, 15, 12; arm, 86, 68; leg, 178, 152; tibia, 60, 50; foot and tarsus, 83, 72.

*Variation:* There is much variation in the general coloration. Specimens may be light clay, olive, blackish or occasionally (probably in the breeding season) may be spotted with orange or crimson.

Young specimens and males may be yellowish white or cream on venter, while the chin and breast may be covered with smoky black flecks, dots, or marblings.

*Distribution:* The species is known in peninsular and western Thailand, specimens having been taken in the provinces of Yala, Trang, Nakhon Si Thammarat, and Chumphon. How far north the species extends has not been determined.

In Malaya the species occurs from sea level to an elevation of 4500 feet. It has been taken in caves deep in the mountains. It has also been taken in southern Burma, Sumatra, Borneo, and Java.

*Remarks:* The species usually remains close to small streams. At Bhetong numerous specimens were acquired from clumps of bamboo growing in the edge of a small stream. The toads were perched among low branches and were easily seized. However, many escaped by plunging into the water.

One popular legend regarding this species is that thieves burn the dried toad skins permitting the smoke to enter a room where persons inhaling the smoke enter a deep sleep, and will not awaken while the room is being robbed.

### *Bufo parvus* Boulenger

FIG. 18

*Bufo parvus* Boulenger, Ann. Mag. Nat. Hist., ser. 5, vol. 19, 1887, p. 346, pl. 10, fig. 3 (type locality, Malacca); Flower, Proc. Zool. Soc. London, 1899, p. 911; Laidlaw, Proc. Zool. Soc. London, 1900, p. 888; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 274; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1916, pp. 42, 170, fig. —; Journ. Federated Malay States Mus., no. 3, 1930, p. 131; Cochran, Proc. U. S. Nat. Mus., vol. 77, 1930, p. 8.



*Diagnosis:* A small toad with supraorbital and parietal bony ridges forming a straight or slightly curved line; a small supratympanic ridge; pair of rather small, somewhat rounded paratoids; snout extending beyond mouth; tibiotarsal articulation reaching to front of tympanum; tympanum distinct, its diameter a little more than two-thirds length of eye; interorbital space broader than an eyelid; first finger extending beyond second.

*Description of species* (from No. 35764, Khao Chong, Trang, May 19, 1958): Canthus rostralis sharp; snout narrowed and projecting considerably beyond mouth, truncate anteriorly; pair of supraorbital ridges continued as strong parietal ridges in straight or somewhat curving lines; edge of eyelid projecting somewhat; a pair of strong but short supratympanic ridges which project outwards; upper eyelid about equal to interorbital width; small slightly diagonal parotoid longer than wide touches supratympanic ridge; loreal region nearly vertical, edge of jaws not visible from above, area slightly concave; tympanum large, close to eye, its greatest diameter nearly three fourths length of eye; tongue slender, elongated, free for half its length; choanae almost completely visible from below; (males with a subgular vocal sac; vocal slit (slits) may be dextral, sinistral, or both).

Arms and legs relatively elongate, slender; tibiotarsal articulation reaching front level of eye; first finger longer than second; subarticular tubercles single, prominent. Two palmar tubercles, outer very large; toes slightly less than half webbed; subarticular tubercles small, indistinct, except on fourth toe; a prominent inner metatarsal tubercle, a smaller outer; no tarsal fold, but an irregular row of somewhat larger spiny tubercles on edge of tarsus; when legs are folded at right angles to body heels do not, or barely, touch.

Head, except interorbital and loreal areas, dorsum, sides, and upper surfaces of limbs covered with various larger, and smaller spiny tubercles producing a very rough surface; chin, breast, venter, and undersurface of limbs with small rounded granules most of which have a small center spine surrounded by several still smaller ones.

*Color in life:* Light brown above, slightly darker on sides; arms and legs dimly banded with darker brown; lower surfaces very indistinctly marked.

*Measurements in mm.* (Nos. 35764, 35766, 34740, respectively): Snout to vent, 47, 42, 35; width of head, 15, 14, 12.6; length of head, 15.3, 14, 12; arm, 33, 27, 25.2; leg, 60, 55, 49; tibia, 19, 17, 15; foot and tarsus, 26, 24.5, 21.



FIG. 18.—*Bufo parvus* Boulenger. Upper figure, No. 34735 ♂; actual snout-vent length, 35 mm. Lower figure, No. 34733 ♀; length, 39 mm. Both from Bhetong, Yala, Thailand.

*Variation:* There is some variation in the length of leg; the tibio-tarsal articulation may reach beyond the eye. Males have a subgular vocal sac which may have a sinistral or dextral vocal slit. One specimen shows two slits. Many specimens have some of the larger dorsal tubercles surrounded with black and occasionally the larger tubercles seem to form a symmetrical pattern. In many males the chin and throat are uniformly blackish olive while the buff or fawn venter is speckled or reticulated with olive.

*Distribution:* The species is well-known in southern Thailand, specimens having been taken at several places in the province of Nakhon Si Thammarat and in "Patiyu [= Prachuap Khiri Khan province], at Bhetong, Yala and Khao Chong, Trang. The species has been reported by Malcolm Smith, on the basis of larval forms, on Khao Seab, Chanthaburi province. It is widely distributed in Malaya in southern Burma, and it has also been taken in Sumatra.

*Remarks:* The species was found breeding May 19-23 in a tiny rivulet that had accumulated a few pools after having been dry for some time. Specimens were taken at one pool on three different nights. Other specimens were found hopping about in open forest.

Malcolm Smith reports that he introduced the species into Bangkok (before May 1917). I have found no specimens or records of its having been taken since. However, no especial effort has been made to discover it.

### *Bufo melanostictus* Schneider

FIG. 19

*Bufo melanostictus* Schneider, *Historiae amphibiorum naturalis et literariae* . . . fasc. primus 1799, p. 216 (type locality "Ex India orientali"); Cantor, *Journ. Asiat. Soc. Bengal*, vol. 16, 1847, p. 1063; Günther, *The reptiles of British India*, 1864, p. 442; Boulenger, *Catalogue of the Batrachia Salientia*, s. *Batrachia Ecaudata* in the collection of the British Museum, 1882, p. 306; *The fauna of British India, Ceylon and Burma; Reptilia and Batrachia*, 1890, p. 505, fig.; Flower, *Proc. Zool. Soc. London*, 1896, p. 911, pl. 44, fig. 3; *ibid.*, 1899, p. 910; Laidlaw, *Proc. Zool. Soc. London*, 1900, p. 888; Butler, *Journ. Bombay Nat. Hist. Soc.*, vol. 15, p. 395; Boulenger, *A vertebrate fauna of the Malay Peninsula* . . . *Reptilia and Batrachia*, 1912, pp. 272-274, fig. 76; *Fasciculi Malayenses, Zoology*, vol. 1, 1903, p. 133; Stejneger, *Bull. U. S. Nat. Mus.*, vol. 58, 1907, p. 72, figs. 58-61; Barbour, *Mem. Mus. Comp. Zool. Harvard College*, vol. 44, no. 1, 1912, p. 73; Smith, *Journ. Nat. Hist. Soc. Siam*, vol. 1, no. 4, Dec. 1915, p. 249 (Koh Chang); *ibid.*, vol. 2, Dec. 1916, p. 17, (Pattani, and Nakhon Si Thammarat); *ibid.*, vol. 2, May 1917, p. 230 ("Common almost everywhere" [in Thailand]); *ibid.*, vol. 2, Dec. 1917, pp. 274-275; van Kampen, *The Amphibia of the Indo-Australian Archipelago*, 1923, pp. 80-81; Nieden, *Das Tierreich*, Anura I, Lief. 46, 1923, p. 116, fig. 167; Taylor and Elbel, *Univ. Kansas Sci. Bull.* vol. 38, 1958, pt. 2, p. 1076; M. Smith, *Bull. Raffles Mus.*, no. 3, 1930, p. 131.

*Bufo meranostictus* (*sic*) Stejneger, *Journ. Coll. Japan*, vol. 12, p. 216.

*Diagnosis:* Medium large toads (snout-to-vent 11.5 mm.); strong canthal, supraorbital, postorbital (pretympanic), supratympanic, and preorbital crests; strong depression between orbital crests; length of orbit slightly greater than snout length; snout rather pointed; parotoids large, much longer than wide, above level of tympanum; body with very numerous warts surmounted by one large and numerous smaller spines; first finger longer than second; subarticular tubercles bifid, often divided rather than single; tibio-tarsal articulation to middle of parotoid; toes about one-third webbed.

*Description of species* ( ♀ specimen, from Chiang Mai, Thailand): Body relatively short; snout rather pointed; canthal crest from above nostril continuous with orbital crest; supratympanic crests and post-orbital (pretympanic) crests present; loreal region sloping somewhat obliquely, shallowly concave; eyelid narrower than distance between supraorbital crests; no parietal crests; supratympanic crest short, thickened; tympanum large (8 mm.) more than half size of eye; parotoid large (25 by 10 mm.), separated from its fellow by a distance of 15 millimeters; deep concavity between crests continued to between parotoids, widest at anterior level of parotoids; pair of prominent rounded warts between anterior part of parotoids; an indistinct horny ridge below eye paralleling ridge on edge of jaw; choanae circular, completely visible from below; ridges behind choanae not meeting mesially; tongue narrowed anteriorly, widened posteriorly, free posteriorly for half its length; (male with nuptial asperities on first and second fingers, and indicated on edge of third); vocal slit either sinistral or dextral (rarely both slits present); a pair of tubercles between parotoids, and two irregular parallel rows of enlarged tubercles on back; these usually capped with horn; warts on side with a larger median and several smaller horny spines; dorsal spines on arms smaller than those on legs.

Digits with horny tips, slightly dilated; large outer and much smaller inner metacarpal tubercle; first finger longer than second; subarticular tubercles of hand partly bifid or double, some single. Toes usually one-third webbed or less; a strong inner metatarsal tubercle and smaller outer; no tarsal fold but in its place a straight row of tubercles; tibiotarsal articulation reaches to midway on parotoid; when legs are folded at right angles heels fail to touch.

*Color:* Above light brown with some reddish brown between parotoids; crests of head, parotoids, and most tubercles covered

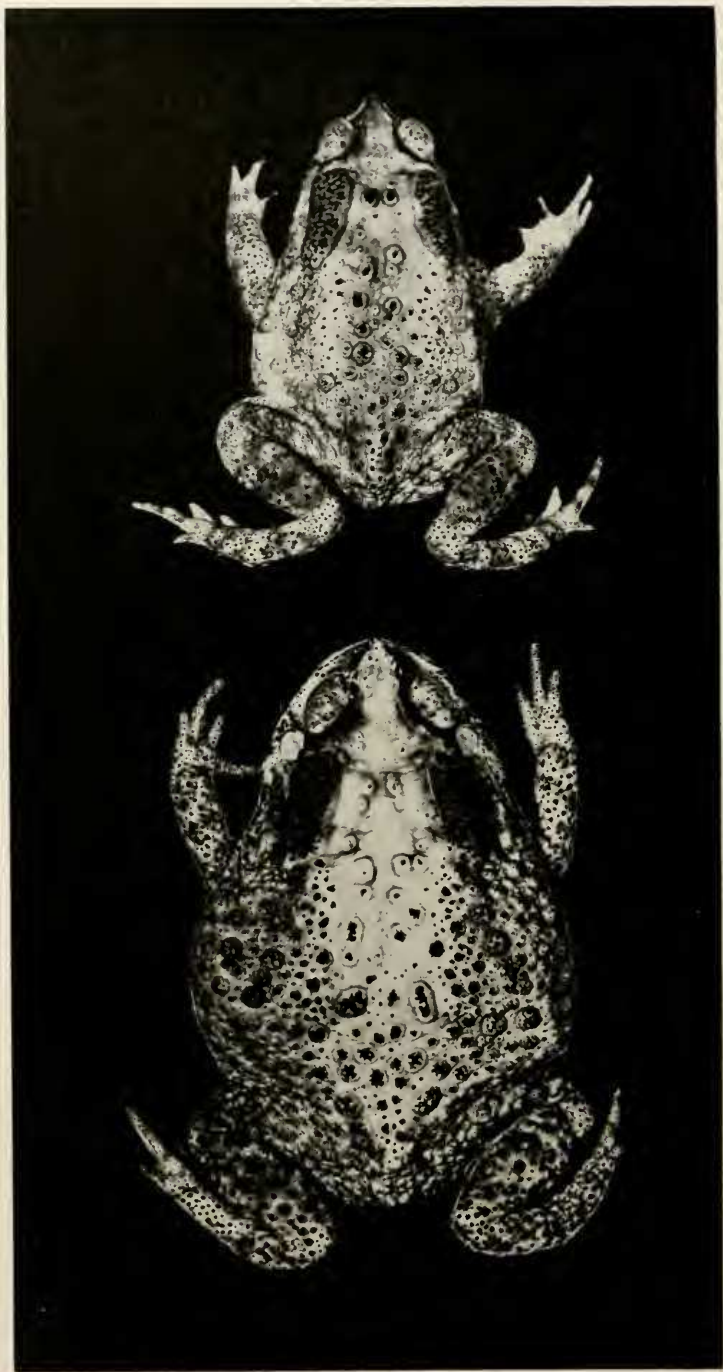


FIG. 19.—*Bufo melanostictus* Schneider. Upper figure, No. 34112. Actual snout-vent length, 71 mm. Lower figure, No. 33722. Length, 101 mm. Both Chiang Mai, Chiang Mai, Thailand.



or topped with black horn; venter fawn, the small spines horn-colored.

*Measurements in mm.:* Snout to vent, 105; width of head, 40; length of head, 29; length of eye, 11; length of snout, 11; diameter of tympanum, 7; length of parotoid, 25; width of parotoid, 13; arm, 60; leg (from vent), 120; tibia, 40; foot and tarsus, 58.

*Variation:* An examination of a large series of specimens from various parts of Thailand showed some minor differences in the populations. Thus, specimens from Muak Lek, Sara Buri province, and Ang Hin, Chon Buri have slightly wider fingers and a median tubercle between the two usual metatarsal tubercles. Also the tympanum is somewhat larger. Certain specimens from southern Thailand have longer more slender fingers and toes with subarticular tubercles less developed than in more northern specimens. A few northern specimens show traces of a parietal crest.

The two tubercles between the parotoids are almost invariably present, more may be present and in a large number of individuals the larger warty tubercles tend to form two parallel rows on each side of the median line of the back; these, however, are rarely regular.

The length of the parotoids varies considerably. The amount of horny material on crests and tubercles varies seasonally and it would appear that this is shed at times, since some individuals have the dark horny material absent from both tubercles and crests.

The color may be light tan dorsally, and some females are light fawn below on chin and venter (Chiang Mai) while females from the central plains (Chon Buri and Sara Buri), may have the chin and breast more or less heavily marked with blackish.

Certain specimens from Renong have the venter largely bright yellow; and the diameter of the tympanum equal to about four fifths of eye-length.

*Distribution:* In Thailand this species has been taken in a large number of provinces, and it probably occurs in every province. Outside of Thailand it has been found in India north to the Himalayas, Burma, S. China, Indo-China, Malaya, and the Indo-Australian Archipelago.

### *Pedostibes* Günther

*Pedostibes* Günther, Proc. Zool. Soc. London, 1875, pp. 576-577 (type of genus *Pedostibes tuberculosus*, from Malabar India).

*Nectophryne*, Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 1882, p. 279.



The brief generic description reads: "Differing from *Callula* in its physiognomy and habit which resembles *Bufo*. Palate concave, without any transverse ridges."

This genus was presumably thought by Günther to belong to the Microhylidae since his generic description compares it with *Kaloula* (*Callula*). The genus was later thrown into the synonymy of *Nectophryne* by Boulenger (1882).

Barbour (1938) has resurrected this genus to include certain species heretofore regarded as *Nectophryne*: *hosii*, Borneo and the Malay Peninsula; *everetti*, Mt. Kinabalu and Mt. Penrisen, Borneo; *altitudinis*, Mt. Kinabalu 7000-10000 ft. altitude; and *kempi*, Garo Hills, Assam.

In Thailand only *Pedostibes hosii* has been taken.

### *Pedostibes hosii* (Boulenger)

FIGS. 20, 21

*Nectophryne hosii* Boulenger, Proc. Zool. Soc. London, 1892, p. 508, pl. 30, fig. 2 (type locality Mt. Dulit, Sarawak, Borneo); Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 19; Roux, Proc. Zool. Soc. London, 1906, vol. 1, p. 59, pl. 2, fig. 1; van Kampen, Amphibien des indischen archipels . . . 1907, p. 413; Barbour, Mem. Mus. Comp. Zool. Harvard Coll. 1912, vol. 44, p. 175; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 268-269; van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, p. 67; M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 129.

*Pedostibes hosii* Barbour, Proc. Biol. Soc. Washington, vol. 51, 1938, p. 192.

*Diagnosis:* A toadlike amphibian with long arms and legs, hand and foot webbed; digits dilated at tips into discs. Pupil horizontal; tongue elliptical without a notch behind; well-developed inner finger; male with an internal subgular vocal sac; outer metatarsals united.

*Description of species* (from M. S. No. 7675, "Setun River, Siam"): Head somewhat concave above, snout narrow truncate; canthus distinct, swollen in front of eye, loreal region concave, oblique; nostrils lateral, close to tip of snout; tympanum distinct preceded, behind eye, by a slight bony elevation; supratympanic ridge somewhat swollen, considerably above and overhanging tympanum; diameter of tympanum scarcely more than half length of eye; interorbital space depressed, twice (or a little more) as wide as upper eyelid.

Tongue narrow, elliptical, free behind; no vomerine teeth; choanae partly concealed when observed from below.

Skin minutely granular on head with a few tubercles above on eyelid; few small scattered warts on dorsum; undersurface of chin, venter, and thigh, granular or areolate; short but distinct parotoid



FIG. 20.—*Pedostibes hosii* (Boulenger) After Roux. Female. Proc. Zool. Soc. London, vol. 1, 1906, pl. 2, fig. 1. Borneo.

gland. Arms long, slender, fingers much depressed, webbed at base, web extending as slender margins to widened terminal discs; first finger shorter than second; toes moderate, flattened, almost completely webbed, tip of digits widened into truncate discs slightly smaller than those on fingers; subarticular tubercles small, feebly prominent; two flat metatarsal tubercles, inner larger; a tarsal fold; tarsometatarsal articulation reaches tip of snout.

*Color:* Uniform brown with some indications of darker markings across legs, and some reticulation on back of thigh.

*Measurements in mm.:* Snout to vent, 63; width of head, 21.6; length of head, 21; arm, 55; leg, 97; tibia, 28; foot and tarsus, 43.

*Variation:* The males and females differ so much in size (females reach a snout-vent length of 100 mm.), in the development of the digital pads, and especially in coloration, that it is scarcely possible to believe they are of the same species.



FIG. 21.—*Pedostibes hosii* (Boulenger) After Boulenger. Male. Proc. Zool. Soc. London, 1892, p. 508, pl. 30, fig. 2. Borneo.

The male may have some indistinct spots on the limbs and the throat may be black. Others may be dark brown with light brown markings which form indistinct coarse vermiculations while the limbs are yellowish brown with indications or transverse bands (Lawas, Brunei).

The females examined have a ground color of black with spots or vermiculations of yellow on head, dorsum, sides and on upper parts of limbs. The concealed parts of the body are dull dirty gray or uniform yellowish. There are yellow spots on lower lip. The

females have fewer and perhaps less conspicuous tubercles. The limbs of both sexes may vary in length, the tibiotarsal articulation sometimes reaching to or near to tympanum, to eye or slightly beyond. There is a tarsal fold present.

The eggs are laid in long strings typical of *Bufo*.

*Distribution:* The inclusion of this species in the Thai fauna is on the basis of a single collection in the province of Satun,\* which borders on the State of Perlis, Malaya.

Malcolm Smith (1930) writes: "My native collector found this toad common in the vicinity of the Setun River (lat. 7° 40' N.) and obtained a large series. He was attracted to the spot after dark by the voices of the males as they were clambering about on bushes and small trees."

The species was originally discovered in Sarawak, Borneo and has been found subsequently in several other places. In Malaya it has been taken in the state of Selangor.

*Remarks:* This species was long included in the genus *Nectophryne*, an African genus. Barbour (1938) with the help of H. W. Parker of the British Museum examined the skeletal and other characters and both agreed that *hosii* and other Asiatic "*Nectophryne*" should be placed in a different genus.

### Genus ANSONIA Stoliczka

*Ansonia* Stoliczka, Proc. Asiat. Soc. Bengal, 1870, p. 152, (type of genus, *Ansonia penangensis*).

A small toadlike amphibian. Fingers elongate, well developed; toes almost completely webbed, the web not thickened; cranial crests absent; tympanum absent. No parotoids glands. A single slit opening into vocal sac.

One species recognized in Thailand.

### *Ansonia penangensis* Stoliczka

FIG. 22

*Ansonia penangensis* Stoliczka, Journ. Asiat. Soc. Bengal, vol. 39, 1870, p. 152, pl. 9, fig. 4, (type locality, Penang I.).

*Bufo penangensis* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum, 1882, p. 287; Flower, Proc. Zool. Soc. London, 1896, p. 911; *ibid.*, 1899, p. 908, pl. 60, fig. 3; Butler, Journ. Nat. Hist. Soc. Bombay, vol. 15, 1904, p. 395; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 270-271, (Penang, 2000 ft. Perak, 2000-3000 ft.); Journ. Federated Malay States Mus., vol. 10, 1922, p. 282, (Kuala Teku and Fraser's Hill, Malaya); M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 129, fig. 6, (Tasan, Isthmus of Kra; and "Benang Star," Yala; mountains of Nakhon Si Thammarat).

\* Often spelled Setul, Satul, or Setun.

*Diagnosis:* A small species (snout to vent, 40 mm.); no bony ridges on head; body slender; parotoid glands very small or absent; tibiotarsal articulation to eye, or between eye and tip of snout; two metatarsal tubercles; no tarsal fold. Fingers rather long with feebly swollen tips, first shorter than second. Dark brown above with fine

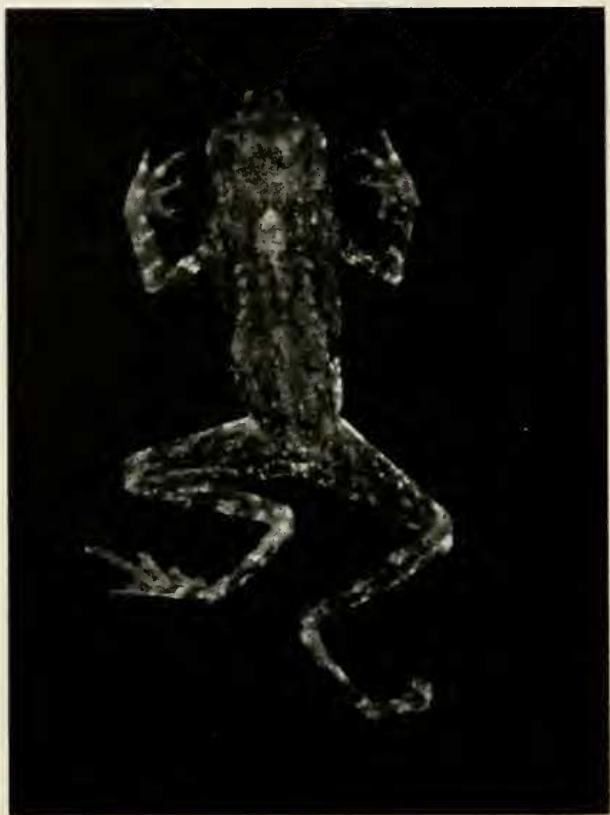


FIG. 22. *Ansonia penangensis* Stoliczka, EHT-HMS 81. Actual snout-vent length, 22 mm. (M. S. 3328), Tasan, Chumphon, Thailand.

white or yellow spots; brownish beneath, speckled yellow or with brown marbling.

*Description of species* (from M. S. No. 3328 (F 81); Tasan, Thailand): Top of head without elevated ridges; snout short obliquely truncate; canthus rostralis rounded, loreal region nearly vertical but slightly concave; snout projecting beyond mouth; nostril nearer



median point of snout than to eye; length of eye a little greater than length of snout; tympanum distinct, its vertical diameter little more than half length of eye, separated from eye by a distance less than half its diameter; small parotoid above tympanum; small gland below tympanum. Tongue elongate, free for nearly three fourths of its length; a long longitudinal slit opens into vocal sac on right side, none on left; choanae visible when palate is viewed from below. Skin on dorsum with unequal-sized warts, the largest arranged dorsolaterally; upper eyelids, sides of neck, sides of body, limbs, and venter covered with granules; chin relatively smooth.

Arms and legs slender; fingers rather long, slender, tips more or less swollen; hand without web; subarticular tubercles absent or indistinct; first finger shorter than second. Toes short, more than half webbed, with indistinct subarticular tubercles and two flat metatarsal tubercles; no tarsal fold; tibiotarsal articulation reaches to near eye.

*Color:* Dark brown above, head a lighter shade than dorsum; a distinct median yellowish spot on shoulders and a few yellow flecks scattered on back and sides; chin, venter, and underparts of limbs deep brown enclosing numerous irregular yellow spots.

*Measurements in mm.:* Snout to vent, 22; width of head, 7.6; length of head, 7.2; arm, 12; leg, 33; tibia, 11; foot and tarsus, 17.

*Variation:* The markings may be brown and white; the tibiotarsal articulation may reach almost to nostril.

*Distribution:* In Thailand the species, so far as known, occurs from the Isthmus of Kra south to Malaya, having been taken in the provinces of Pattani, Nakhon Si Thammarat, and Chumphon.

Elsewhere it occurs in Malaya (Penang and Perak) and Borneo.

#### FAMILY ATELOPODIDAE

A small toadlike amphibian, originally named *Hylaplesia borbonica* by Boie (1826), was later referred to the genus *Bufo* by Cope, 1867, and Boulenger (1882). Here it remained until van Kampen (1923) placed it in the genus *Nectophryne*. Davis, (1935) in a study of the form proposed the genus *Cacophryne*. He pointed out that its relationship was not with the *Bufo*nidae but with the South American family *Atelopodidae*.

One other member of this family has been recognized in Asia by Brongersma.



*Cacophryne* Davis

*Cacophryne* Davis, Zool. Ser. Field. Mus. Nat. Hist., vol. 20, no. 12, May 5, 1935 (type of genus *Hylaplesia borbonica* Boie).

**Diagnosis:** Vertebral column procoelous. Pectoral girdle completely firmisternal; sternum slender and cartilaginous; omosternum absent; sacral diapophyses widely expanded; coccyx and sacrum fused; maxillary and vomerine teeth lacking; prevomer small, ethmoid entire, palatine present. Ear complete; no palatal folds; Eustachian tubes present. Terminal phalanges simple, no intercalary cartilages. Pupil horizontal. Narrow inconspicuous parotoid glands present. Habitus slender with elongated limbs.

Davis calls attention to the apparent distributional anomaly in having in Asia, a monotypic genus referable to a South American family Atelopodidae. He points out another similar case, that of *Nothopsis*, a new world representative of a subfamily represented elsewhere only in Southeastern Asia.

*Cacophryne borbonica* (Boie)

FIG. 23

*Hylaplesia borbonica* Boie (Kuhl and van Hasselt in Schlegel), Isis, vol. 20, 1826, p. 294 (*nomen nudum*); Schlegel, Bull. Sci. Nat. Férussac, vol. 9, 1826, p. 239 (*nomen nudum*); Tschudi, Mem. Soc. Sci. Nat. Neuchâtel, vol. 2, 1839, p. 70; Peters, Monatsb. Acad. Wiss. Berlin, 1863, p. 81.

*Bufo borbonicus* Cope, Journ. Acad. Nat. Sci. Philadelphia, vol. 6, 1867, p. 193; Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 1882, p. 286 (*part.*); Horst, Notes Leyden Mus., vol. 5, 1883, p. 236; Mocquard, Arch. Mus. Paris ser. 3 vol. 2, 1890, p. 122; Boettger, Katalog der Batrachier-Sammlung im Museum der Senckenbergischen naturforschenden Gesellschaft, 1892, p. 33; van Kampen, Zool. Jahrb., Java, vol. 22, 1905, p. 713; Amphibiens des Indischen Archipels . . . 1907, p. 413; Robinson and Kloss, Journ. Federated Malay States Mus., vol. 8, 1920, p. 306; Bourret, Les batraciens de l'Indochine, 1942, pp. 167-169, fig. 24.

*Bufo borbonica* M. Smith, Sarawak Mus. Journ., vol. 3, 1925, p. 30; Bull. Raffles Mus., no. 3, 1930, p. 130.

*Nectophryne borbonica* van Kampen, Notes Leyden Mus., vol. 34, 1911, p. 75; The Amphibia of the Indo-Australian Archipelago, 1923, p. 20, fig. 7.

*Nectophryne sumatrana* van Kampen, Naturk. Tijdschr. Ned.-Ind., vol. 69, 1910, p. 19, pl. 1, fig. 1.

*Bufo jerboa* Boulenger, Proc. Zool. Soc. London, 1890, p. 328, pl. 25, fig. 3; A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 271; van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, p. 76; Noble, The Biology of the Amphibia, 1931, p. 502, fig. 161 (reprinted 1954).

*Cacophryne borbonica* Davis, Field Mus. Nat. Hist. Zool. Ser., vol. 20, 1935, pp. 87-92.

**Diagnosis:** A small slender species, head without bony ridges; canthus angular; leg long, tibiotarsal articulation reaching nearly to



FIG. 23.—*Cacophryne borbonica* Boie. From Boulenger, Proc. Zool. Soc. London, 1890, p. 328, pl. 25, fig. 3, "Bufo jerboa." Actual snout-vent length, 30 mm. SE Borneo.

tip of snout; toes half webbed; paratoids small, two on each side; blackish or brownish with white spots; marbled brown below.

*Description of species* (from Boulenger's description of *Bufo jerboa* 1912. This has been synonymized with *Cacophryne borbonica*. It must appear that, if this is fact, the southern Thai specimens should resemble more the population described as *jerboa* since Boulenger identifies specimens from Gunong Inas, northern Perak as belonging to *jerboa*. Perak borders Thailand on the south): Body very slender; head lacking trace of crests or bony ridges; snout obliquely truncate, strongly projecting beyond mouth; loreal region vertical; interorbital space as broad as or a little narrower than upper eyelid; tympanum distinct one half to two thirds diameter of eye, and close to latter. Fingers long and slender, with feebly swollen tips, first as long as or a little shorter than second; toes short, one-third to one-half webbed with very prominent subarticular tubercles; two small but prominent metatarsal tubercles; a tarsal fold; tibiotarsal articulation reaches far beyond tip of snout; tibia about two thirds length of head and body. Upper parts with granules and very small warts; venter granulate; paratoids, if at all distinct, very narrow.

*Color:* Brown above, with dark and light spots or symmetrical markings, often forming an X-shaped figure in front of sacral region; a yellowish dorsolateral streak sometimes present; dark bars on limbs and on lips; yellowish or pale brownish beneath, throat and breast dark brown or much mottled with dark brown.

*Measurements in mm.:* Snout to vent, 50.

*Distribution:* In Thailand the species has been taken in the province of Trang and at Kuan Nieng, southwest of Phatthalung, Phatthalung province.

It was originally found in Java, while the type of *Bufo jerboa* came from southeastern Borneo (first mentioned by Fisher, Arch. Nat., 1885, p. 43 as *Bufo leptophis*).

#### FAMILY HYLIDAE

This great family, comprising chiefly arboreal frogs is very poorly represented in Asia. On the other hand Australia, South America, and North America have numerous species. They are absent or rare in Africa.

A single species is known from Thailand, a species much better known in Burma.

The Hylidae may be described as follows: Arboreal or sec-

ondarily terrestrial frogs. Vertebrae procoelian, lacking free ribs; coccyx attached to sacrum by paired condyles; sacral diapophyses dilated except in terrestrial species; an arciferal pectoral girdle. Coracoids and precoracoids connected by an arched cartilage, that on one side overlapping that of the other; omosternum and sternum of cartilage. Upper jaw with teeth; terminal phalanges claw-shaped, separated from penultimate phalanx by an intercalated cartilage. A frontoparietal fontanelle.

A single genus *Hyla*, is represented.

#### Genus *HYLA* Laurenti

*Hyla* Laurenti, Specimen medicum, exhibens Synopsis Reptilium emendatum cum experimentis circa venena et antidota Reptilium Austriacorum, 1768, pp. 32, 33 (type of genus, *Hyla viridis*).

**Diagnosis:** Characters of family. Sternum a cartilaginous plate; outer metatarsals almost completely united; fingers free or more or less webbed; toes webbed, tips dilated into larger or smaller discs; pupil horizontal; tongue entire or notched behind; vomerine teeth usually present. Tympanum distinct or hidden.

A single species is present in Thailand.

#### *Hyla annectens* (Jerdon)

*Polypedates annectens* Jerdon, Proc. Asiat. Soc. Bengal, 1870, p. 84 (type locality, Khassya Hills, N. India).

*Hyla annectens* Günther, Proc. Zool. Soc. London, Nov. 16, 1875, p. 576 (closely allied to *Hyla chinensis*); Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd Ed., 1882, p. 382; Ann. Mus. Civ. Genova, ser. 2, vol. 6, 1888, p. 593; The fauna of British India. . . . Reptilia and Batrachia, 1890, p. 509; Slater, Proc. Zool. Soc. London, 1892, p. 348; Boulenger, Ann. Mus. Civ. Genova, 1893, ser. 2, vol. 13, pp. 311, 343; Fea, *ibid.*, ser. 2, vol. 17, 1897, p. 476; Nieden, Das Tierreich, Lief. 46, Anura I, Subordo Aglossa und Phaneroglossa Sectio I Arcifera, 1923, pp. 201-202; Vogt, Zool. Anz., Leipzig, 1924, p. 343; Parker, Ann. Mag. Nat. Hist., ser. 9, vol. 15, 1925, pp. 305; Gee and Boring, Peking Nat. Hist. Bull., vol. 4, pt. 2, 1930, pp. 24, 39; Pope, Bull. Amer. Mus., vol. 61, 1931, p. 474; Bourret, Annexe. Bull. Inst. Publ., No. 4, 1939, Dec., p. 58; Pope and Boring, Peking Nat. Hist. Bull., vol. 15, 1, 1940, p. 37; Bourret, Les Batraciens de l'Indochine, 1942, pp. 222-223.

**Diagnosis:** A member of the *Hyla arborea* group; a strong, tubercular fold from eye to shoulder; black spots along flanks.

**Description of species:** Tongue circular, slightly nicked and free behind; vomerine teeth in two groups on level with posterior edge of choanae; head broader than long; snout short, rounded; canthus rostralis distinct; interorbital space as broad as upper eyelid; tympanum distinct, about half diameter of eye. Fingers webbed at base; toes two-thirds webbed, discs well developed. Tibiotarsal articulation reaches tympanum or eye; skin smooth above, granular

on ventral surface; strongly tuberculated fold from eye to shoulder; male with vocal sac; black nuptial excrescences on first finger of male.

*Color:* Green above; a light-edged dark lateral streak terminates posteriorly in two or three black spots, separated or confluent on groin, which is bright yellow; sides of thighs with deep black spots on a bright yellow ground; two outer fingers and two outer toes green; beneath, whitish immaculate.

*Measurements:* Snout to vent approximately 50 mm.

*Distribution:* The species is known from northwestern Thailand at Mae Hong Son. It occurs also in Burma.

*Remarks:* Pope (1931) has shown the close relationship between the Asiatic mainland species of *Hyla*. Two forms that presumably differed, *Hyla albotaeniata* Vogt and *Hyla bambusicola* Barbour have been shown to be species of the genus *Rhacophorus*, and consequently in a different family.

The arborea group of *Hyla* also occurs in America. A species group in Mexico (including *euphorbiacea*, *cárdenasi*, *eximia*, *arboricola*, *lafrentzi*, and *wrightorum*) must be regarded as members of the *arborea* group. Some populations of *arborea* are so similar to *lafrentzi* that they can be separated only with considerable difficulty, if at all.

### Family Ranidae

Four genera of this family are recognized as occurring in Thailand. They may be identified by the following key:

#### KEY TO THE THAI GENERA OF THE FAMILY RANIDAE

- |   |                      |
|---|----------------------|
| 1. No vomerine teeth .....  | 2                    |
| Vomerine teeth present .....  | 3                    |
| 2. Tongue elongated, narrow, pointed behind .....   | <i>Ooeidozyga</i>    |
| Tongue rounded behind without notch .....   | <i>Phrynoglossus</i> |
| 3. Small species, tongue narrow not divided posteriorly; vomerine teeth present .....             | <i>Elachyglossa</i>  |
| Small and large species; tongue divided posteriorly; vomerine teeth present (rarely absent) ..... | <i>Rana</i>          |

#### Genus OOEIDOZYGA Kuhl and van Hasselt

*Ooeidozyga* Kuhl and van Hasselt, Isis, 1822, p. 475 (type of genus, *O. lima*); M. Smith, Proc. Zool. Soc. London, 1927, p. 202.

*Diagnosis:* Small frogs; tympanum covered with skin; pupil of eye horizontal; fingers with web-remnant; toes fully webbed; sub-articular and metacarpal tubercles somewhat titlike; tongue pointed



behind; no vomerine teeth; lateral-line (neuromast) system retained in adults; skin even on palms and soles, covered throughout with pearly, often spinous, tubercles; slightly widened terminal discs on toes or none; three metacarpal and two metatarsal tubercles; tarsal fold indicated; outer metatarsals separated by web; a small spine-covered process near posterior underside of tarsus. Omosternum with a bony style; tips of digits simple without intercalated bone or cartilage between two terminal phalanges.

*Ooeidozyga lima* Kuhl and van Hasselt

FIG. 24

*Ooeidozyga lima* Kuhl and van Hasselt, Isis, 1882, p. 475 (type locality, Java); M. Smith, Proc. Zool. Soc. London, 1927, p. 202; Bull. Raffles Mus., no. 3, 1930, pp. 92, 135; Pope, Bull. Amer. Mus. Nat. Hist., vol. 61, Aug. 29, 1931, pp. 481-484; M. Smith, Bull. Raffles Mus., no. 5, 1931, p. 16, Boring, Mem. B. A. China Rep., 1932, p. 104; Taylor, Lingnan Sci. Journ., vol. 13, 1934, p. 304; Bourret, Les Batraciens de l'Indochine, 1942, pp. 398-401, figs. 131-132 (literature list); Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, 1958, pp. 1048-1049 (Nakhon Phanom).

*Oxyglossus lima* Tschudi, Classification der Batrachier . . . 1838, p. 85; Günther, The reptiles of British India, 1864, p. 401; Boulenger, Catalogue of the Batrachia Sientia s. Ecaudata in the British Museum, 1882, p. 5; The fauna of British India, Ceylon and Burma; Reptilia and Batrachia, 1890, p. 436; Flower, Proc. Zool. Soc. London, 1899, p. 886; Laidlaw, *ibid.*, 1900, p. 884; Boulenger, Fasciculi Malayenses., Zoology, pt. 1, 1903, p. 134; A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 225; Vogt, Sitzungsab. Ges. Nat. Berlin, 1911, p. 143; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 2, Dec. 1916, p. 164 (Klong Wang Hip, Nakhon Si Thammarat); *ibid.*, pp. 172-175, pl.; *ibid.*, vol. 2, no. 3, May, 1917, p. 227.

*Oxydozyga lima* Stejneger, Proc. U. S. Nat. Mus., vol. 66, 1925, p. 33.

*Diagnosis:* Small aquatic frogs, maximum size about 39 mm.; tongue elongate, extensively free, pointed behind; fingers acutely pointed, first equal to second; two or three distinct metacarpal tubercles; two metatarsal tubercles, and a strong tubercle on end of tarsus; skin very rough, tubercular or spiny; linear series of warts, marking lateral line (neuromast) organs, on venter, sides, and chin; male with internal vocal sac; continuous dark and light transverse stripes on back of thighs; fingers with slight web; toes fully webbed (see also generic characters).

*Description of species* (from female specimen Bangkok): Small species (about 40 mm. females); snout short, a rather pointed oval; canthus rostralis not indicated; nostrils on two elevated swellings raised above level of snout, distance between them (1.5 mm.) less than interorbital distance (1.8 mm.); loreal region oblique with slight depression or concavity behind nostril; tympanum large distinct, covered with skin, its greatest diameter (2.9 mm.) less than

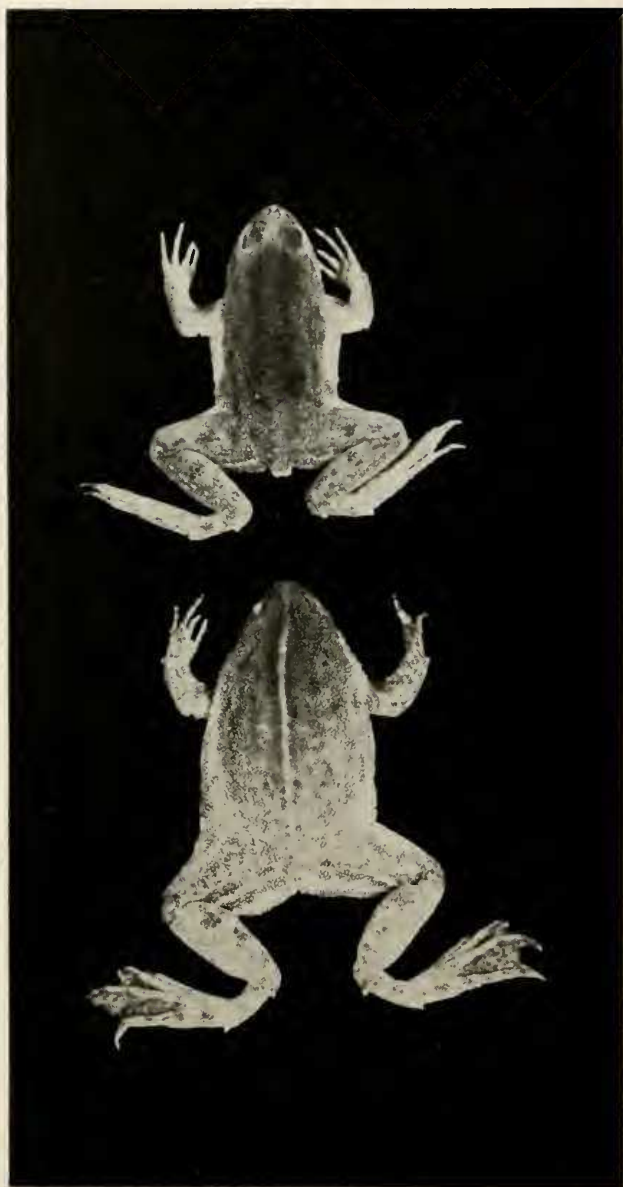


FIG. 24.—*Oecidozyga lima* Kuhl and van Hasselt. Upper figure, No. 1053 ♂. Actual snout-vent length, 29 mm. Chon Buri. Lower figure, No. 33201 ♀. Length, 35 mm. Polo Field, Bangkok.

length of eye (3.7 mm.); width of eyelid (1.7 mm.) about equal to interorbital distance.

Tongue terminating posteriorly in a point, free behind for two thirds of its length; choanae at anterior end of palate partly overhung by median part of premaxillary shelf; no trace of palatal gland openings; (males with a vocal sac, the openings near jaw somewhat in advance of jaw-angle).

Arms short with elongate pointed digits; proximal subarticular tubercles somewhat distinct, titlike; small distal one on third finger only. Fingers about one-fourth webbed, webs continuing to near tips as narrow fringes; two (occasionally three) metacarpal tubercles; legs short, tibiotarsal articulation reaches to tympanum; toes pointed, subarticular tubercles distinct; two strong metatarsal tubercles, inner largest, compressed, elevated; toes fully webbed, only extreme tips of fingers free; outer metatarsal separated by web; small tarsal fold, and in line behind this a tarsal tubercle covered with small spines and tubercles.

Skin everywhere with pearly tipped tubercles or spines, even on undersurface of soles, palms, and digits; lateral-line system represented by a series of organs on wartlike elevations beginning on side near axilla, continuing back across groin to underside of femur, a narrow  $\Delta$ -shaped series on throat, and one or two vertical series in groin, each elevation bearing from one to four pores.

*Color:* On dorsal surfaces, dark olive with dark spots or flecks scattered thickly on back, sides, and limbs; snout darker olive; tympanic area brown; on middle of side an indefinite black line below which is an indefinite greenish-cream line, distinct in region of groin; deep-black elongate spot under arm; two dark lines begin on breast, extend forward to tip of chin and meet; chin, breast, and venter cream with a fine powdering of blackish brown; black line from axilla to groin below cream line; black line from groin onto undersurface of thigh forming an angle; deep black stripe continuous across posterior surface of femora with numerous pearly dots; cream line both above and below black stripe; upper line again bordered by a blackish broken line outlined narrowly in cream; strong black line from upper end of tarsus to tip of outer toe.

*Measurements in mm.* (from 33204 ♀, and 33203 ♂, Bangkok): Snout to vent, 36, 30; width of head, 12, 11; length of head, 11, 10; arm, 18.2, 18; leg, 50, 49; tibia, 16, 14; foot and tarsus, 21, 23.

*Variation:* The markings of the described female agree with those of several other gravid female specimens and a few males. Certain others from the same locality differ in having the back uniform olive, the sides without lines, the venter very lightly pigmented and the ventral lines entirely absent or only dimly indicated; the posterior markings on the thighs are usually present.

A series of specimens from Kanchanaburi taken near the city of the same name are light gray-brown and cream-white below. Under a microscope one can discern the typical markings of the venter outlined in minute pigment dots. The lateral-line system is very clearly defined in these.

Many specimens have a slight fold across back of head.

*Distribution:* In Thailand the species has been obtained in lowlands where collections have been made and probably it occurs in all the provinces. Outside of Thailand it occurs in Burma, Indo-China, Hainan, Malaya, and Java.

*Remarks:* The tadpole of the species described by Pope (1931) is very different from most Ranid tadpoles in lacking the external teeth about the mouth.

#### Genus PHRYNOGLOSSUS Peters

*Phrynoglossus* Peters, Monatsb. K. Akad. Wiss. Berlin, 1867, pp. 29-30 (type species *Phrynoglossus martensii* Peters); Malcolm Smith, Bull. Raffles Mus., no. 3, 1930, p. 135; and *ibid.*, no. 5, 1931, p. 135.

*Oreobatrachus* Boulenger, Ann. Mag. Nat. Hist., ser. 6, vol. 17, May 1896, p. 401 (type of genus, *O. baluensis* Boulenger); M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 135; *ibid.*, no. 5, 1931, pp. 3-32.

This genus was proposed by Peters for a frog which was similar to *Ooeidozyga lima* but which differed from it chiefly in the character of the tongue; seemingly it was generically related to *Ooeidozyga laevis* which species was also placed in the new genus. Peters' name in turn was placed in the synonymy of *Ooeidozyga* (or one of its synonyms) where it remained until M. Smith (1931) pointed out that *Phrynoglossus* was a legitimate genus.

Inger (1954) has proposed to place *Micrixalus diminutiva* Taylor in the genus *Ooeidozyga* but it would appear that this should stand as *Phrynoglossus diminutivus*. Since he does not discuss the presence or absence of the lateral-line system one suspects that he is unaware that it occurs in *laevis* but is not evident in *Phrynoglossus*. His whole discussion of the genus and its Philippine variants is obscured by his display of mathematics.

*Phrynoglossus magnapustulosus* (Taylor and Elbel)

FIG. 25

*Micrixalus magnapustulosus* Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, Mar. 20, 1958, pp. 1066-1068, fig. 9 (type locality Ban Na Phua, Kan Luang, Nakhon Phanom province, elev. 200 m.).

*Diagnosis:* Related to *Phrynoglossus martensii* but with a series of relatively very large pustules each surmounted by a single tiny rounded pearly tubercle. Similar tubercles but smaller above tibia and tarsus; tongue oval, wider posteriorly than anteriorly, and free behind for one third its length; no vomerine teeth, eye longer than snout; tympanum covered with skin its outline partly discernible; toes four-fifths webbed, a distinct web-remnant between first and second fingers.

*Description* (from type description): Tip of snout broadly oval, nostrils slightly elevated, situated about an equal distance from eye and from median point on edge of upper lip, separated from each other by a distance equal to or very slightly less than median length of snout; width of an eyelid equal to or slightly less than interorbital distance; tympanum moderately distinct, covered with skin, its diameter (1.5 mm.) much less than length of eye-opening (2.2 mm.); a sinuous fold from eye extends back for a short distance behind mouth-angle; no canthus rostralis; loreal area slightly convex rather than excavated; snout extends beyond mouth for about half a millimeter; eye large, strongly elevated, its length greater than median length of snout, but equal to a line from eye to middle point on upper lip.

Tongue a little longer than wide (3 x 2.7 mm.) free posteriorly for about one third of its length, and free laterally; no tongue papilla, but surface minutely granular; choanae small, nearly lateral, not concealed by maxillary shelf when seen from below; no trace of vomerine teeth; openings of Eustachian tubes smaller than choanae; no evidence of vocal slits. Symphysis of lower jaw without distinct denticulate elevation.

Arm short, only fingers reaching beyond tip of snout; first finger very little longer than second; a distinct vestige of a web, edges of digits not or but slightly ridged on sides. Three small palmar tubercles, inner and outer a little more distinct than middle one, outer elongated and completely separated from middle one; four distinct subarticular tubercles.

Leg short, toes four-fifths webbed, tibiotarsal articulation reach-





FIG. 25.—*Phrynoglossus magnapustulosus* (Taylor and Elbel)  
EHT-HMS No. 31838 ♂. Actual snout-vent length, 16 mm.  
Ban Na Phua, Kan Luang, Nakhon Phanon, Thailand.

ing middle of eye; toes with only slight development of terminal discs; web reaching discs on one or more toes; well-defined, somewhat compressed, elongate inner metatarsal tubercle; very tiny outer tubercle situated at terminus of slight pustular ridge along outer toe; well-developed subarticular tubercles; a short diagonal tarsal fold extending less than half length of tarsus; when legs are folded at right angles to body heels fail to touch.

Skin on snout and interorbital area with a very indistinct elevation across head between anterior edges of eyes (the "eyespot" included); body with large craterlike pustules, the sides of which are excavated by numerous "valleys"; pustules pearl-tipped; between larger pustules there are tiny pustules; sides with less distinct pustules; legs with numerous smaller pearl-tipped pustules tending to form longitudinal rows; chin nearly smooth; venter without distinct

granules; underside of thighs smooth except on posterior part; posterior face of thighs with very few scattered granules.

*Color in preservative:* Generally brown above with two vague lighter areas on middle of back preceded and followed by slightly darker areas or lines; upper side of upper arm fawn-brown, forearm banded with brown. Leg including tarsus, and foot, with narrow bands; below, chin and throat brownish with some lighter flecks; venter and part of underside of thighs nearly immaculate; soles dark lavender; posterior part of thighs brownish.

*Measurements in mm.* (Type): Snout to vent, 16; width of head, 7; length of head, 6; arm, 8; leg, 22.5; tibia, 7; foot, 7.7.

*Variation:* This form has been taken in several localities in eastern, northern, and northwestern Thailand. All of the specimens show the presence of the short web between the first and second fingers. This is quite unusual since in most species where the hand has a web-remnant the outer fingers (third and fourth) will more often display the remnant; usually in such cases the web is lacking between the first and second fingers or it is negligible. When compared with *martensii* in southeastern Thailand, the heads are proportionately narrower. There also is some differences evident in the front of the palate when this and *martensii* are compared.

*Distribution:* In Thailand known only from Nakhon Phanon, Ubon, Loei, and Chiang Mai provinces.

*Phrynoglossus laevis* (Günther)

FIGS. 26, 27

*Diagnosis:* A small frog; tongue oval, rounded behind free for about one fourth its length, somewhat free on sides; tympanum covered with skin, dimly visible, a little more than half diameter of eye; first finger shorter than second; second and third fingers with partial fringe most distinct on second finger; tibiotarsal articulation reaches slightly in front of eye; heels overlap strongly; distinct discs on toes, their upper surface usually divided by deep grooves; terminal phalanx blunt at tip; toes almost fully webbed; strong compressed inner metatarsal tubercle, very small outer; a tarsal fold; lateral-line system retained in adult.

*Description of species:* (From No. 34752 Pattani, Pattani). Head flattened, snout oval, not or only slightly projecting beyond lower jaw; no canthus rostralis; loreal region broadly oblique; nostril dorsal, closer to anterior tip of snout than to eye; snout rounded in lateral profile; slight diagonal ridge suggested in back part of loreal region



FIG. 26.—*Phrynoglossus laevis* (Günther). No. 34752. Actual snout-vent length, 26 mm. Pattani, Pattani, Thailand.

behind which lies a slight depression which touches eyelid; width of upper eyelid greater than interorbital width; tympanum (2.1 mm.) little more than half length of eye (3.6 mm.); length of snout (3.65 mm.) about as long as eye; slightly tubercular fold from lower eyelid, crosses upper third of eyelid; fold from mouth-angle back to behind jaw-angle.

Choanae rather large, on anterior part of palate, not concealed when palate is viewed from below; tongue oval, rounded behind, free for about one-fourth of its length, somewhat free on sides; no trace of vomerine teeth.

Arm short, if brought forward only tips of fingers reaching tip of snout; first finger not extending as far forward as second; fringe on second finger extending part of distance on each side; fringe on inner side of third finger; tips of fingers swollen a little; proximal subarticular tubercles moderately well developed; distal ones on third and fourth fingers obsolete; two distinct metacarpal tubercles, inner larger, median obsolete.

Toes rather elongate, digital tips forming somewhat elongate discs with deep groove dividing its upper surface; terminal phalanx blunt at tip; no groove across under surface of disc; subarticular tubercles small, distinct; large compressed elevated inner metatarsal tubercle; outer small, at end of fold along outer edge of fifth finger. Toes five-sixths webbed; well-defined inner tarsal fold half length of tarsus; an indistinct outer fold suggested also. Tibiotarsal articulation reaches to just beyond eye. When legs are folded at right angles to body heels overlap.

Skin on snout smooth; on occiput and back finely corrugate; two indistinct dorsolateral lines begin behind eye and are lost on shoulder; sides of body with glandular tubercles; skin on legs, especially exposed surfaces, with fine pearl-capped tubercles, the tubercles extending onto sole of foot. Skin of chin, breast, venter, and much of concealed surface of limbs, smooth.

*Color:* Above olive-brown to brown, with two darker lines following dim dorsolateral folds; a dark and a light transverse line across head between eyes; two or three cloudy areas on back; arms light brown, flecked with darker brown; flecks of brown on thighs; tibia, tarsus, and foot with dark-brown bars; entire undersurface of body and limbs uniform white or with few scattered punctate spots on breast and numerous larger dark-brown spots on underside of legs; a slightly lighter area on side of head from eye to arm-insertion.



FIG. 27.—*Phrynoglossus laevis* (Günther) EHT-HMS No. M145 ♀.  
Actual snout-vent length, 33 mm. Pahang, Malaya.



*Measurements in mm.* (from No. 34752, Pattani, Pattani; and No. M. 145, Pahang, Malaya): Snout to vent, 26, 33; width of head, 12, 14.2; length of head, 11.4, 12; arm, 14, 16; leg, 40, 49.5; tibia, 14, 17; foot and tarsus, 17, 21.5.

*Variation:* The specimen from Pahang has the lip and the loreal region darkened. There is a light olive bar between the eyes, bordered behind by a black line and an indistinct darker line in front. The occiput and front of shoulders are uniform gray-olive. The fold curving back and down from the eye is dark; a tiny broken dorsolateral ridge gives the body a decidedly angular appearance; some black flecks on back. A distinct fold in front of breast; and a somewhat lunate dark spot in groin preceded by a curved series of small glandular tubercles.

The pattern of the lateral-line system of *laevis* differs somewhat from that of *lima*. The tubercles on the Pahang specimen are more distinct than in the described specimen.

The tubercles with pores are distributed as follows: two parallel rows of three on the throat; a row of four on each side just preceding the breast fold; two or three near angle of jaws; four above arm-insertion; a series of five in axilla; four in a curved vertical row on side in front of groin; a series of six or eight beginning above vent cross the base of the femur, perhaps a part of the lateral series immediately preceding it.

In the described specimen the lateral-line pore bearing tubercles are less distinct but with care they can be found in about the same numbers and in the same position. Besides these, there are numerous glandular tubercles with small pearly tips. If the pearly portion is shed or removed these too may appear to have a pore. Some tubercles have only a single pore, others may have three or four.

A specimen from Singapore M. 146, differs in being deep brown on all dorsal surfaces except the snout which is uniform white, and there are a few scattered black spots.

The tubercles are wanting (or flattened) but the pores can be seen clearly under a lens. Their arrangement is as follows: there are four groups discernible under the eye, four behind the eye following the supratympanic fold, five above arm-insertion, eight in a longitudinal lateral row, eight or nine across base of femur and to above vent, four in axilla, three in a posterior lateral vertical series, two or three in a transverse series on throat, two or three at jaw angle, and a pair on back of chin. A few show some elevation

and the number of pores varies from one to four, but most of the tubercles are completely flattened and only pores are discernible.

*Distribution:* This species is known to occur only in the southern part of Thailand, and presumably throughout Malaya. There is no certainty that this is specifically identical with Günther's *Oxyglossus laevis* from the Philippines, or with the form so called from the Indo-Australian Archipelago. Larger collections may show that the Singapore specimen discussed merits specific recognition if the characters are constant.

*Remarks:* The Singapore specimen has an oval tongue showing a tiny posterior notch. This may be accidental but may suggest still another difference from the Pattani and Pahang forms. The discs on the toes are somewhat larger, elongate oval in shape. Under no circumstances can one consider *martensii* a subspecies of this form. Examination of various Philippine populations show differences in the detailed characters of the lateral-line system.

### *Phrynoglossus martensii* Peters

FIG. 28

*Phrynoglossus martensii* Peters, Monats. Akad. Wiss. Berlin, 1867, p. 29 (type locality, Bangkok, Siam).

*Oxyglossus martensii* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd ed. 1882, p. 6; Flower, Proc. Zool. Soc. London, 1899, p. 887; M. Smith, and Kloss, Journ. Nat. Hist. Soc. Siam, vol. 1, pt. 3, 1915, p. 248.

*Oxydozyga martensii* Cochran, Proc. U. S. Nat. Mus., vol. 77, 1930, p. 2.

*Ooeidozyga laevis* (part.) Bourret, Les Batraciens de l'Indo-Chine, 1942, p. 401-404, fig. 134.

*Diagnosis:* Differs from *Phrynoglossus laevis* in having very small terminal discs on tips of digits, lacking dorsal longitudinal grooves. Distinctly smaller than *laevis*.

The two species occur together in southern Thailand.

*Description of species* (from No. 35876, Khao Chong, Trang, southern Thailand): Head rather flattened, oval in outline; no canthus rostralis; nostril a little nearer corner of eye than to anterior median point on snout; width of an eyelid greater than inter-orbital distance; nostril surrounded by a distinct swelling; tympanum covered with skin, but most of the outline distinct, separated from the eye by a distance equal to about half diameter of tympanum; a fold beginning at posterior corner of eye passes down and back diagonally across tympanum to near arm; a small indistinct fold from mouth-angle passing back to a point in front of arm-insertion; tongue rounded behind without notch, sides nearly

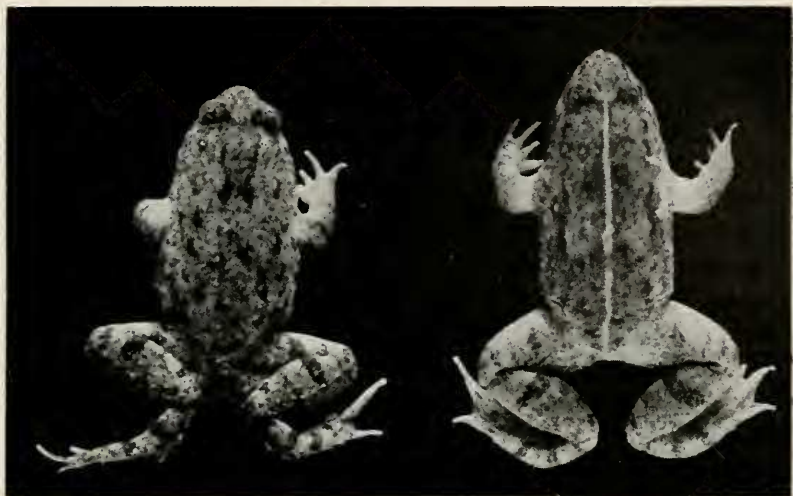


FIG. 28.—*Phrynoglossa martensi* Peters. Left figure, No. 1225 ♂. Actual snout-vent length, 27 mm. Right figure, No. 35794 ♂. Actual length, 26 mm. Khao Chong, Trang.

parallel, free behind for one fourth or less of its length; choanae visible seen directly from below, not concealed by jaw.

Arm short, first finger longer than second; second and fourth of same length, third finger longest; distinct inner and outer metacarpal tubercles, the middle somewhat obsolete; no trace of a web between first and second fingers; leg moderate in length, tibiotarsal articulation reaching eye; toes with terminal discs not or scarcely larger than those on fingers; toes three-fourths to four-fifths webbed, the webs somewhat incised between digits; a large projecting shovellike tubercle more than half length of first toe; a small distinct tarsal fold; no outer tubercle; a slight ridge of skin on outer edge of outer toe; skin with a few small scattered tubercles posteriorly on dorsum, nearly smooth on anterior part of dorsum and head; on posterior half of tibia and on tarsus numerous small tubercles; chin, venter and underside of thighs smooth; a suggestion of a fold across breast, and a faint fold across head behind orbits.

*Color:* Head brownish gray, clouded or flecked with darker; indefinite lighter spots on tip of snout and along upper lip; ground color of dorsum brownish gray; a broad brownish stripe on back arising on occiput, fading on rump, flanked by two broad stripes of ground color; an indefinite dorsolateral line from eye along side becoming wider posteriorly; venter and underside of limbs yellow-

ish-white to flesh-white, but with a fine peppering of darkish pigment, somewhat denser on chin and throat, and outer parts of the underside of thighs; pigment dense on underside of foot, less so on hand; arms indistinctly spotted or barred; legs with more distinct brown bars.

*Measurements in mm.*: Snout to vent length, 25.5; width of head, 9; length of head, 9; arm, 12; leg, 36.

*Variation*: The chief observable variation has to do with the details of the markings. Some specimens are covered with scattered brown spots and the pattern as described is obsolete. An occasional specimen may have a narrow median cream line.

*Distribution*: The species occurs throughout peninsular Thailand and probably also throughout the central part of the country.

*Remarks*: The relationship of this form is with *magnapustulosus* a form as yet not well established. Further work is being undertaken to determine the true relation of these forms.

#### Genus ELACHYGLOSSA Andersson

*Elachyglossa* Andersson, Kungl. Svenska Vetensk.-Akad. Hand; Band 55, no. 4, 1916, p. 13.

*Diagnosis*: "This new genus of the family *Ranidae* is nearly allied to *Oxyglossus*, but differs in having vomerine teeth, tympanum distinct, a large head, depressed body and differently shaped hind feet. The diagnosis of the genus may be as follows: Sternal apparatus of the firmisternian type; upper jaw very distinctly toothed; diaphyses of sacral vertebra not dilated. Pupil horizontal. Tongue free, narrow and entire. Vomerine teeth present. Tympanum distinct. Fingers free, toes webbed, the fourth toe much the longest; tips of fingers and toes feebly dilated into very small disks. Outer metatarsals separated by web. Omosternum with a bony style, sternum a cartilaginous plate. Terminal phalanges of fingers transversely dilated; no intercalary ossification between the distal and penultimate phalanges."

#### *Elachyglossa gyldenstolpei* Andersson

FIG. 29

*Elachyglossa gyldenstolpei* Andersson, Kungl. Svenska Vetensk.-Akad. Hand., Band 55, No. 4, 1916, pp. 13-14, 2 figs. in text (type locality, Bang Hue Pong village southern slope Koon Tan mountains, northern Siam).

*Diagnosis*: See characters of the genus.

*Description of species* (type description): "Vomerine teeth in two rather long oblique series behind the small choanae. Tongue very small, narrow, extensively free, and bluntly pointed behind, very



FIG. 29.—*Elachyglossa gyldenstolpei* Andersson. After Andersson, Kungl. Svenska Vetensk-Akad. Hand. Band 55, 1916, fig. 2 in text. "Bang Hue, Pong Koon Tan Mountains," N. Siam. Actual length, 23 mm.

small in proportion to the wide mouth. Head large, broad, and flattened; the greatest breadth of the head equal to the distance between the tip of the snout and the hind margin of the tympanum. Snout rounded, a little longer than the diameter of the eye; canthus rostralis indistinct. Loreal region oblique, deeply concave. Inter-orbital space broader than the upper eyelid. Nostril nearer the tip of the snout than the eye. Tympanum distinct, three fifths diameter of eye. Fingers free, rather long, the first not quite reaching the tip of the second; toes nearly entirely webbed, the web reaching the disks, except in the 4th toe, two joints of which are free; the web of the other toes as well is deeply emarginate; the 4th toe considerably longer than the 3rd and 5th; tips of fingers and toes with very small disks; terminal phalanges of fingers somewhat dilated, those of toes pointed; subarticular tubercles very distinct, especially on the fingers; a single, compressed inner metatarsal tubercle, no outer; if the dimension of the tibia is marked off from the knee forwards along the body, it reaches the tip of the snout.

"Skin very finely chagreened above, and provided with some irregular warts, smooth below.

*Color*: "Above dark greyish brown with irregular black dots; between the eyes a light transverse band, bordered behind by black;



limbs reddish, transversely barred with dark; inner side of tibia uniform pale flesh-coloured; below dirty whitish yellow, the limbs reddish."

*Measurements in mm.*: "Total length, 23; width of head, 10.5; length of head (from the hind margin of tympanum), 10; length of snout, 4.5; diameter of eye, 3.4; diameter of tympanum, 2; length of humerus, 4.2; from elbow to tip of third finger, 10.2; length of femur, 12.2; length of tibia, 12.1; length of tarsus with fourth toe, 17.

*Remarks*: "One specimen from Bang Hue Pong, a small village on the southern slopes of the Koon Tan Mountains in Northern Siam, 7/5/1914."

This species has not been rediscovered. I have not seen the type.

One might suspect that did the specimen prove to have the lateral-line system developed, it represents a close relative of *Phrynoglossus laevis* differing chiefly in the presence of vomerine teeth.

### Genus RANA Linnaeus

*Rana* Linnaeus *Systema Naturae* . . . Ed. 10, vol. 1, 1758, p. 210 (type of genus, *temporaria*).

*Diagnosis*: Large and small frogs, with a horizontal pupil, maxillary and vomerine teeth; tongue free, deeply notched posteriorly. Tympanum usually visible, often hidden under skin; fingers unwebbed with pointed or dilated tips. Outer metatarsals usually separated by a web. Omosternum and sternum with a bony portion.

This is the most populous group of the Salientia in Thailand and while recognized as being composite is treated as a single genus. Thirty-four species are recognized. I have included *Rana scutigera* but suspect this may belong in another genus.

The following key will be of assistance in recognizing most species at least the males. In certain cases it is difficult to separate the females.

#### KEY TO THAI FROGS OF THE GENUS RANA

1. Lateral-line system retained in adults, indicated by a series of pores; two external vocal sacs opening through two slits below corners of mouth; toes pointed; no dorsolateral fold; no outer metatarsal tubercle . . . . . *cyanophlyctis cyanophlyctis*
- Lateral-line system not present in transformed frogs or if present tongue not notched behind . . . . . 2
2. Skin of head partly ossified and fused to skull bones; no dorsolateral line (possibly a *Rhacophorus*) . . . . . *scutigera*
- Skin of head not partly ossified and fused to bones of the skull . . . . . 3



- Head more or less enlarged; sexual dimorphism strong; with or without postorbital bead or flap; with or without bony processes in lower jaw of male; if without processes, vomerine teeth weak or absent or skin very fragile . . . . . 15
15. Toothlike processes in lower jaw of male . . . . . 16  
 No toothlike processes in lower jaw of male . . . . . 19
16. No free process or flap in postorbital area . . . . . 17  
 A free flap or process in postorbital area . . . . . 18
17. Only a slight swelling on the head, maximum size 42 mm. . . . . *kochangae*  
 A very distinct postorbital swelling reaching the level of anterior border of tympanum; heels overlapping; maximum length 58 mm. . . . . *macrognaethus macrognaethus*
18. Postorbital swelling flaplike the edges free laterally and posteriorly; its width in adult distinctly greater than interorbital width; larger to 64 mm. . . . . *pileata*  
 Postorbital swelling, small rounded bead or process, one to two millimeters in length; body with numerous longitudinal folds; smaller, to 43 mm. . . . . *plicatella*
19. Vomerine teeth poorly developed or more frequently absent; head broader than long; canthus rostralis obtuse, concave loreal region; tympanum one half of eye diameter; first finger shorter than second; tibiotarsal articulation to between eye and tip of snout; toes webbed at base; no outer metatarsal tubercle; small to 28 mm., no vocal sac . . . . . *tenasserimensis*  
 Vomerine teeth well developed . . . . . 20
20. First finger shorter than second; toes half webbed; canthus obtuse, loreal region oblique concave; tympanum very distinct, one half to three fifths of diameter of eye; tibiotarsal articulation near to tip of snout; no outer metatarsal tubercle; a glandular network of fine folds on body; the skin fragile . . . . . *tasanae*  
 First finger longer than second . . . . . 21
21. Canthus distinct, tympanum distinct, three fifths to three fourths of the eye diameter; internal vocal sacs in male; round outer metatarsal tubercle; oval gland on arm and a pad on first finger in male; yellowish or reddish dorsolateral lines . . . . . *signata*  
 Canthus obtuse, indistinct, or absent . . . . . 21a
- 21a. Skin smooth; small outer metatarsal tubercle; no vocal sac or pad on first finger in male; head depressed; reddish or chocolate brown, . . . . . *luctuosa*  
 Skin on body completely covered with large flat granules; a dorsolateral fold may be indicated by linear arrangement of glandular granules; males with vocal sacs and large oval gland on inner part of arm . . . . . *glandulosa*
22. Dorsolateral fold broad . . . . . 23  
 Dorsolateral fold narrow . . . . . 24
23. First finger longer than second; a small outer metatarsal tubercle; gland on arm in male . . . . . *nigrovittata*  
 First finger equal or shorter than second; no outer metatarsal tubercle; dorsolateral light stripes . . . . . *erythraea*
24. A humeral gland present . . . . . 25  
 No humeral gland present . . . . . 28

25. External vocal sac opening below jaws; diagonal ridges on back; a strong swelling on first finger of male ..... *miopus*  
Internal vocal sacs present ..... 26
26. A gland on breast and one on inner side of arm; canthus strong, loreal region oblique, deeply concave; tympanum nearly as large as eye; no peripheral groove around digital disc ..... *cubitalis*  
No gland on breast; humeral gland present ..... 27
27. A peripheral groove about small digital discs; canthus distinct; a small outer metatarsal present; throats of males blackish with a longitudinal light line ..... *nicobariensis nicobariensis*  
No digital discs; no peripheral groove about slight terminal digital swelling; canthus distinct. No median light line on dark chin and throat ..... *lateralis*
28. Discs feebly expanded with peripheral groove. Head much longer than broad; body slender with three to five longitudinal golden or yellowish lines; first and second fingers equal ..... *macrodactyla*  
Discs strongly expanded with peripheral groove, no longitudinal golden lines on body ..... 29
29. External vocal sacs; first and second fingers about equal ..... 30  
Internal vocal sacs; first and second fingers variable in length ..... 31
30. Finger discs large, equal to tympanum; canthus rostralis obtuse; tibiotarsal articulation reaches beyond tip of snout; no outer metatarsal tubercle; toes webbed to discs ..... *livida*  
Finger discs much smaller than tympanum; toes entirely webbed ..... *jerboa*
31. A small outer metatarsal tubercle; first finger longer than second. An indistinct brown lateral stripe; legs long and slender reaching tip of snout or beyond tip of snout; terminal discs smaller than tympanum ..... *alticola*  
No lateral stripe ..... 32
32. Digital discs longer than wide, often pointed at tips; smaller, to 66 mm. .... *chalconota*  
No outer metatarsal tubercle; large frogs, 100 mm.; discs large, largest equal to tympanum; tibiotarsal articulation to far beyond tip of snout; dorsolateral glandular fold distinct anteriorly ..... *hosii*

*Rana cyanophlyctis cyanophlyctis* Schneider

FIG. 30

*Rana cyanophlyctis* Schneider, *Historiae Amphibiorum naturalis et literariae* fasc. 1, 1799, p. 137 (type locality, oriental India); Peters, *Mon. Berlin Akad.*, 1863, p. 78; Günther, *The reptiles of British India*, 1864, p. 406; Steindachner, *Reise der österreichischen Fregatte Novara*. . . . Amphibia, 1867, p. 20; Stoliczka, *Proc. Asiat. Soc. Bengal*, 1872, p. 102; Boulenger, *Catalogue of the Batrachia Salientia s. Batrachia Ecaudata*. . . . in the British Museum, 1882, p. 17; *The fauna of British India Ceylon and Burma*; Reptilia and Batrachia, 1890, p. 442; Anderson, *Proc. Zool. Soc.*, London, 1895, p. 660, pl. 37, fig. 2; Ferguson, *Journ. Bombay Soc. Nat. Hist.*, vol. 15, 1904, p. 500; Boulenger, *A vertebrate fauna of the Malay Peninsula*. . . . Reptilia and Batrachia, 1912, pp. 228-229 (doubtful report of the species by Cantor at Penang, Malaya); Annandale, *Journ. Nat. Hist. Soc. Siam*, vol. 2, 1916, p. 91 (Inland Sea, Singgora = [Songkhla]); *Mem. Asiat. Soc. Bengal*, vol. 6, 1917, p. 145 (Phatthalung province. Same specimens as preceding reference.); Annandale and Rao,

Rec. Ind. Mus., vol. 15, 1918, p. 30, fig.; M. Smith, Rec. Ind. Mus., 1929, vol. 31, p. 77; Bull. Raffles Mus., no. 3, 1930, pp. 92, 95; Bourret, Les Batraciens de l'Indochine, 1942, pp. 237-239.

*Rana bengalensis*, Gray, Illustrations of Indian Zoology, 1834, p. 77.

*Rana leschenaultii* Duméril and Bibron, Erpétologie Générale . . . vol. 8, 1841, p. 342; Cantor, Journ. Asiat. Soc. Bengal, vol. 16, 1847, p. 1059.

*Diagnosis:* Rather large frogs (to 100 mm.); three or more paired series of lateral-line pores on body; no canthus rostralis; tympanum large, distinct; male with small, widely separated, external vocal sacs; toes fully webbed.

*Description of species* (from EHT-HMS No. 31094): Large frogs to 100 mm. snout-vent length; head rather small, snout oval; canthus rostralis indistinct, loreal region sloping obliquely, slightly concave; eye length shorter than length of snout; tympanum distinct, large, its diameter three fourths eye length, separated from eye by distance little less than half diameter of tympanum; upper eyelid wider than interorbital space.

Vomerine teeth very few, on small elevations between choanae, but widely separated from them, close together, barely extending



PLATE 30.—*Rana cyanophlyctis cyanophlyctis* Schneider. EHT-HMS No. 31094 ♂. Actual snout-vent length, 58 mm. Trincomalee (12 mi. N.) Ceylon.



back of posterior level of choanae; palatal glands opening in distinct curved groove midway between vomerine teeth and front end of palate; tongue long, with two long posterior horns, free for about one third of its length. Pair of small external vocal sacs extruded close to each jaw on chin; vocal slits in mouth posteriorly placed.

Skin with small granular tubercles varying in size on dorsum and upper surface of head and limbs; a dorsolateral row of pores extending from eye to groin; a ventrolateral row meeting posteriorly and outlining venter but extending anteriorly above arm-insertion;\* two other short curving rows one on either side of the breast and a line across breast, meeting its fellow on sternal area.

Fingers somewhat swollen at tip but not widened; fingers slender with very tiny web rudiment and lateral ridge extending to near tip on inner edge of three outer fingers; first finger as long as second, or slightly longer; subarticular tubercles prominent; metacarpal tubercles small, rather indistinct; toes swollen and widened slightly, completely webbed, webs reaching discs on all toes; subarticular tubercles distinct; inner metatarsal tubercles elongate, compressed terminal portion free and slightly pointed; no outer tubercle; distinct skin-fold on outer side of first and fifth toes; small tarsal fold; leg rather short, tibiotarsal articulation reaching just beyond level of eye; when legs are folded at right angles to body heels fail to meet by several millimeters.

*Color in life:* Above and on sides olive or brown-olive with numerous dark-olive spots of varying sizes somewhat symmetrically placed; arms and legs strongly barred or spotted with dark olive; chin, venter, and under limbs, yellowish with greenish or small olive dark marks; back part of thigh, dark olive reticulated with gray; a more or less continuous transverse, white line behind thighs below which is a similarly broken olive line; web of foot spotted olive.

*Measurements in mm.:* Snout to vent, 58; width of head, 21; length of head, 17; arms, 31; leg from vent, 83; tibia, 25; foot and tarsus, 38.

*Distribution:* In Thailand the species has been reported from the Tale Sap, Inland Sea, by Annandale. An older report from Penang, Malaya has been questioned. It is obvious that this species is rare, and one might suspect its presence in Phatthalung province as the result of an accidental introduction into the area, and perhaps a recent one if the Penang record is to be discounted.

\* These pores are difficult to distinguish, however some of the specimens have each of the pores infested with a small cestode (?) worm, black in color that causes the pores to be conspicuous. It is presumed that these pores represent remains of the neuromast [lateral line] system of the larval amphibians and fishes. These pores are retained in adults of certain other aquatic species such as *Ooeidozyga lima*. Some glands as well as pores are present above vent.

The species is otherwise distributed from South Arabia, Baluchistan and India to Ceylon.

*Remarks:* The specimen here described is from Ceylon where it is very common. It has the habit of hopping on the surface of water, often making a dozen leaps before sinking.

I observed a moderately large pool, in a partly dry stream bed, with a population of perhaps more than a hundred frogs. When I approached all took off and every frog found refuge in the same hole in the bank several feet above the waters edge before I reached the place. This same thing happened on three different occasions save that I approached under cover and came very close before they were disturbed.

*Rana tigerina* Daudin

*Rana tigerina* Daudin, Histoire naturelle des rainettes, des grenouilles et des crapaud. 1802 (an XI), p. 42, pl. 20 (type locality, Bengal India).

The frogs of this group, since there is more than a single subspecies, have been confused in literature. Boulenger and Annandale have considered the facts and have been able to separate *cancrivora* as a separate species, but they have failed to agree on all points. The form most commonly encountered at and near Bangkok is the very large one originally named *Hydrostentor pantherinus*, by Fitzinger in 1861, with Hong Kong the type locality.

*Rana tigerina pantherina* (Fitzinger)

FIG. 31

*Hydrostentor pantherinus* Fitzinger, Sitz. Kais. Akad. Wiss. Wien., Band 42, 1861, p. 414 (type locality, Hong Kong).

*Rana tigrina pantherina* Steindachner, Reise der österreichischen Fregatte Novara in. 1857, 1858, 1859: Amphibien, Zool. Theil., Bd. 1, 1867, p. 17, pl. 1, figs. 14-17; Boulenger, Rec. Indian Mus., vol. 20, June, 1920, p. 17.

*Rana tigerina pantherina* Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, 1958, pp. 1050-1052.

*Rana tigrina* (part.) Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 234; Robinson and Kloss, Journ. Federated Malay States Mus., vol. 5, 1915, p. 155 (Koh "Pa-ngan").

*Rana tigrina* Cantor, Journ. Asiat. Soc. Bengal, vol. 16, 1847, p. 1060; Boulenger, Catalogue of the Batrachia Salientia, s. Ecaudata in the British Museum, 1882, p. 26 (part.); Flower, Proc. Zool. Soc. London, 1896, p. 901; *ibid.*, 1899, p. 891, pl. 59, fig. 2; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 197.

*Diagnosis:* Large species 160 + mm. in length. Differs from the typical form in a somewhat shorter leg reaching between shoulder and eye, heels not or scarcely overlapping when folded. Inner

metatarsal tubercle blunt; dark and light bars on lips; lower parts may be spotted, or with a streak on throat.

*Description of species* (from No. 993 ♀, Chalermklaub, Siracha, Chon Buri): Head much widened, considerably wider than long; canthus rostralis obtuse, loreal region strongly oblique, shallowly concave; nostril much nearer tip of snout than to eye; eye length about equal to its distance from nostril; tympanum large, its diameter (8 mm.) equal to nearly two thirds of eye length (11 mm.); tympanum largely directed upwards, separated from orbit by a distance little greater than half its diameter; eyelid a half wider than inter-orbital width; a strong supratympanic fold curving from eye above and behind tympanum.

Vomerine teeth on two elongate oblique ridges practically continuous with anterior rim of choanae, running back behind level of choanae, narrowly separated mesially; openings of palatal glands in a curved median row closer to front of palate than to anterior level of choanae; males with two lateral vocal sacs, rather small, evidenced by external folding of skin on under side of head; vocal slits in mouth are far back near mouth-angle and likely to be overlooked.

Arm moderate, fingers slightly swollen at tips with a fleshy lateral fringe on inner side of first finger, less strong on distal half on outer side; on distal half of third finger, fold or ridge strong on inner side only; leg moderately long, tibiotarsal articulation reaching front of eye; when legs are folded at right angles to body, heels touch but barely overlap; toes with small terminal swellings, five-sixths webbed to fully webbed, membranes reaching discs, but somewhat excised between digits. A strong compressed elongate inner metatarsal tubercle; no outer; a skin-flap on outer side of fifth toe; a tarsal fold; subarticular tubercles of hand rounded, of toes more elongate.

Skin of front of head smooth; dorsum and dorsal surface of legs heavily covered with smaller tubercles and larger pustular warts; tubercles on limbs often pearl-capped; elongate glandular ridges from one to twelve millimeters in length; on tibia tubercles may form elongate rows connected by low ridges; entire ventral surface smooth.

*Color:* Above olive-brown (greenish-olive in life) with numerous small black spots; lips with large dark spots separated by cream; sides and front of thighs yellow-cream mottled with darker; back of thighs black reticulated with cream or white, and with dark flecks



FIG. 31.—*Rana tigerina pantherina* (Fitzinger). No. 33532 ♀. Actual snout-vent length, 140 mm. Samut Sakhon, Thailand.

and a few small peripheral spots; venter and undersurfaces of limbs white; soles and palms blackish.

*Measurements in mm.*: Snout to vent, 120; width of head, 53; length of head, 46; arm, 59; leg, 186; tibia, 55; foot and tarsus, 80.

*Distribution*: Butler writes (1903) "I am inclined to think this frog must be rather local in its distribution in the Peninsula and probably more abundant in the Siamese States than in the South."

I have specimens from Chon Buri, and Bangkok. The subspecies *pantherina* ranges from Burma through Thailand to Indo-China and Formosa. (See Boul. Rec. Ind. Mus.) Reports of the subspecies from Madras may be the results of artificial introductions.

*Rana rugulosa* Wiegmann \*

FIG. 32

*Rana rugulosa* Wiegmann, Nova Acta Acad. Leopold . . . vol. 17, p. 258, pl. 21, fig. 2 (type locality, cape Syng-more, Macao); Annandale, Mem. Asiat. Soc. Bengal, vol. 6, 1917, pp. 126-127, pl. 5, fig. 3, 3a, 3b (Burma, Yunnan; Bangkok and Lop Buri, Siam); Boulenger, Rec. Ind. Mus., vol. 15, 1918, pp. 52-53; Annandale, *ibid.*, vol. 15, 1918, pp. 60-61; Cochran, Proc. U. S. Nat. Mus., vol. 77, p. 3, 1930; Pope, Bull. Amer. Mus., no. 61, 1931, p. 487, fig. VI; Taylor, Lingnan Sci. Journ., vol. 13, 1934, p. 472.

*Rana tigrina* Anderson, Anatomical and Zoological Researches . . . vol. 1, 1878, p. 837 (*part.*).

*Rana tigrina* Stejneger, U. S. Nat. Mus. Bull., vol. 58, 1907, p. 139, figs. 127-131.

*Rana burkhilli* Annandale, Rec. Ind. Mus., vol. 5, 1910, p. 79.

*Rana tigrina rugulosa* Bourret, Les Batraciens de l'Indochine, 1942, pp. 242-245, figs. 55-57 (*part.*); Tchang and Boring, Peking Nat. Hist. Bull., vol. 14, 1939-40, p. 228; Pope and Boring, *ibid.*, vol. 15, 1940, pp. 48, 49.

**Diagnosis:** A frog reaching a length of approximately 85 mm.; arms and legs moderately short. Toes nearly fully webbed; digit without discs, tips of toes slightly swollen at tip, no outer metatarsal tubercle; about ten rows of warts and ridges on back. Interorbital space much narrower than upper eyelid.

**Description of species** (from No. 34889, Ubon, Ubon): Snout oval, canthus distinct, loreal region oblique, concave, concavity with slight median longitudinal elevation; jaw forming slight shelf below eye; nostril much nearer eye than median tip of snout; two small lateral swellings below nostrils; tympanum covered with skin, distinct with a small central circular elevation, its distance from eye about one third its diameter (4.8 mm.); length of eye (6.5 mm.) shorter than snout (9.8 mm.); width of upperlid (5.9 mm.) more than twice interorbital distance (2.3 mm.).

Vomerine teeth in two elongate ridges arising from upper anterior edge of choanae, extending diagonally, very narrowly separated mesially; line of pores across palate near its anterior end mark the openings of palatal glands; choanae small, not concealed when viewed from below but somewhat overhung by vomerine ridges; tongue large, free for two fifths of its length, broadly attached anteriorly.

\* Without an examination of the materials on which many reports of the presence of *rugulosa* and *tigrina* (*tigrina*) are based, it is impossible to place them properly in synonymy.



Arm short; first finger longer than second, second and fourth extend forward same distance; first finger with a distinct nuptial pad not extending onto distal joints; subarticular tubercle large, flat, no trace of web but some lateral ridges indicated on inner edge of second to fourth fingers; inner metacarpal tubercles moderately distinct; outer practically indiscernible.

Leg short, tibiotarsal articulation to front of eye; subarticular tubercles small; rather small inner metatarsal tubercle; no outer;



FIG. 32.—*Rana rugulosa* Wiegmann. No. 34889, Ubon, Ubon. Actual length, snout to vent, 66 mm.

toes five-sixths to fully webbed, slightly excised; outer metatarsal separated by web. Faint tarsal fold indicated. All digits rather pointed, without small discs.

Skin rugose on sides and dorsum with nine or ten irregular rows of elongate warts or ridges; upper eyelids rugose; arms smooth above; leg and foot with small pearly tipped tubercles tending to form lines on tibiae; skin of ventral surfaces smooth; few small pearly tipped tubercles about vent; strong fold from eye curving around behind tympanum.

*Color:* On back of head brownish olive, somewhat lighter on sides; side of head with four black spots separated by small cream spots. Arms and legs indistinctly barred with dark olive; numerous indefinite black spots on sides and larger ones on dorsum; front of thigh with a row of black spots; on back of thigh numerous black spots in lighter reticulum; very slight indefinite gray marks on chin.

Measurements in mm. of *Rana rugulosa*

	Ubon	Bang Saen	Doi Suthep
Number.....	34889	821	36581
Sex.....	♂	♀	♀
Snout to vent.....	68	85	82
Width of head.....	28	38	33
Length of head.....	22	30	35
Tympanum.....	4.8	7	6
Eye length.....	6.5	10	7
Snout length.....	9.8	12.5	12
Arm.....	31	41.3	38
Leg.....	97	119	105.6
Tibia.....	31.5	39	35
Foot and tarsus.....	49.2	58	53

*Rana raja* M. Smith

FIG. 33

*Rana cancrivora raja* M. Smith, Bull. Raffles Museum, no. 3, 1930, pp. 96-97 (type locality, Pattani, Pattani, Thailand).

*Diagnosis:* A large species, female reaching a length of 121 mm. snout to vent; canthus rostralis rather distinct; skin of back with a few longitudinal warts or folds, without or rarely with median stripe; first finger longer than second, tips slightly narrowed just back of slight terminal swelling; skin-flap on outer side of fifth toe; a small compressed, anteriorly pointed metatarsal tubercle; toes about three-fourths webbed or a little more; vomerine teeth ridges

arising directly against or near anterior internal border of choanae, narrowly separated mesially; small openings into two lateral vocal sacs, near inner edge of lower jaw.

*Description of species* (from B. M. 1947, 2.3.88 ♀, Pattani, Pattani province, Thailand): Head oval, distance between canthi small; canthi distinct, obtuse, nostril situated little closer to eye (9.5 mm.) than to median point on upper lip (10.1 mm.); width of eyelid greater than interorbital distance; diameter of tympanum (7.2 mm.) less than length of eye (10.5 mm.); length of snout, 15 millimeters; distance between tympanum and eye, 5 millimeters; loreal region broadly oblique, somewhat concave. Palatal glands open into transverse groove nearly midway between front of palate and anterior level of choanae; vomerine teeth on ridges arising at anterior inner edge of choanae, extending back obliquely, narrowly separated mesially; tongue large, free behind for little more than one third of its length; (male with small vocal slits opening into vocal sacs); openings of Eustachian tubes larger than choanae.

Skin with a few folds varying in length on back, and with few small tubercles; distinct fold from eye to above tympanum bending down behind tympanum to above arm-insertion; limbs rather smooth above and below; chin and venter smooth; few indistinct warts or flat tubercles about vent.

Tips of digits very slightly swollen at tip; inner metacarpal tubercle elongate, two outer fused, flattened; first finger longer than second; toes about three-fourths webbed; two distal phalanges of fourth toe without web; a small metatarsal tubercle, its length slightly less than half its distance from tip of inner toe; when legs are folded at right angles to body, heels barely touch; tibiotarsal articulation reaches to eye.

*Color*: Broad clay-gray median stripe from lip to vent; back gray-brown to brown, some folds edged with black or black-brown with few rather larger blackish spots; thighs with dark bars; back of thigh black, reticulated with cream; tibia, feet, and arms with blackish spots; dark loreal line; lip, chin and lower jaw with dark brown spots separated by cream spots; spots on venter and underside of thighs cream-white; a light area under tibia; brownish on underside of foot.



FIG. 33.—*Rana raja* M. Smith. No. 34839 ♂. Actual snout-vent length, 84 mm., near Phatthalung, Phatthalung, Thailand.

Measurements in mm. *Rana raja*

Number. ....	34839	34836	34837	34838	MS No. 4395	MS No. 7442
Sex. ....	♂	♀	♀	♀	♀	♂
Snout to vent. ....	84	109	113	98	119.5	88
Width of head (tympanum) ..	31	46	47	36.2	46	32
Length of head to jaw-angle	30	41	41	35	42	31
Length of eye. ....	8	9.8	10.8	10		
Length of snout. ....	11.6	17	15	16.3		
Eye to tympanum. ....	4.1	4.5	5	4.8		
Tympanum diameter. ....	5	6.8	7	7		
Arm. ....	44	57	58	51	53	43.5
Leg. ....	122.6	159	168	163	162	126
Tibia. ....	40	57	60.5	53	55	40
Foot and tarsus. ....	60	81	83	77	77	58

*Variation:* The specimens above (Nos. 34836-39) were taken at Phatthalung in fields of rice about two kilometers from the Tale Sap (Sea of Singgora).

The male has well-developed vocal sacs with large black spots covering them on the throat; the vocal slits in the mouth are small but distinct and back near the angle of the mouth. The females are gravid.

Females have about ten large spots along lower jaw, while the chin, throat, and front of breast is nearly covered with thirty or forty dark spots and flecks separated by areas of yellowish-white color. In No. 34838 these markings are dim to obsolete. The venter is yellowish white in all. The web is rather deeply excised in all the specimens and the terminal swellings vary slightly.

I have examined the type series in the British Museum. The largest paratype (cotype) ♀ measures 121 mm., and a male 62 mm. snout to vent. Both lack a median stripe. My measurements of two of the types differs slightly from those published by Dr. Smith.

*Distribution:* Known from Pattani, Songkhla, and Phatthalung in Thailand. I have examined specimens of this species from Kuala Lumpur.

*Remarks:* The species *cancrivora* is highly specialized with regards salt toleration. It is usually to be found in the vicinity of the seashores or mouths of rivers. The species here considered seemingly is not so confined in its distribution and there is no evidence that either adult or tadpole is salt tolerant. There are no vocal sacs in *cancrivora*, however, two are present in this species.



*Rana cancrivora* Gravenhorst

FIG. 34

*Rana cancrivora* Gravenhorst, Deliciae Musei Zoologici Vratislaviensis continens Chelonios et Batrachia, fasc. 1, Lipsiae, 1829, p. 41 (type locality, Java); Annandale, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 2, 1916, pp. 91, 96; Mem. Asiat. Soc. Bengal, vol. 1, 1917, pp. 121, 128, pl. 5, fig. 4; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1917, p. 228; *ibid.*, 1917, p. 256; *ibid.*, 1917, p. 264 (Chumphon); Annandale, Rec. Ind. Mus., vol. 18, 1918, p. 63, figs. 3, 3a; Boulenger, Rec. Ind. Mus., vol. 15, pt. 2, no. 7, Apr. 1918, pp. 55, 65-67; Rec. Ind. Mus., vol. 20, 1920, p. 23; Robinson and Kloss, Journ. Federated Malay States Mus., vol. 8, 1920, p. 305; van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, pp. 170-172; Sworder, Singapore Naturalist, no. 5, 1925, p. 99; Cochran, Proc. U. S. Nat. Mus., vol. 77, 1929, p. 3; Bourret, Les Batraciens de l'Indochine, 1942, pp. 245-248, figs. 58-59 (nearly complete synonymy, and literature list).

*Rana tigrina* (sic) (part.), Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 234.

*Rana cancrivora* forma *typica* \* M. Smith, Bull. Raffles Mus., no. 3, Apr. 1930, p. 97.

**Diagnosis:** Nostrils directed upward; the interorbital width about one half width of an eyelid; nostril nearer tip of snout than eye; loreal region oblique, concave; tympanum distinct; first finger longer than second; tibiotarsal articulation to eye; when legs are folded, heels touch; fringe on outer side of outer toe; slight tarsal fold; inner metatarsal tubercle; no outer; numerous dorsal folds; dorsolateral fold suggested, composed of numerous short ridges in line; vomerine teeth oblique extending much behind small choanae; toes about three-fourths webbed; small eye-spot in middle of frontal area.

**Description of species** (from No. 34294, ♀ Ang Hin, Chon Buri province, Thailand): Snout pointed oval; nostril a little closer to median tip of snout than to eye; canthus rostralis not indicated, loreal region oblique somewhat depressed, concave, with few small smooth warts; width of eyelid greater than interorbital distance; small supratympanic fold extending diagonally to above tympanum then bending downward and backwards behind tympanum but not obscuring tympanic ring; diameter of tympanum little greater than distance between tympanum and eye; yellowish gland at angle of mouth touching tympanum.

Internal nares small; vomerine teeth on two narrow diagonal ridges beginning on anterior inner edge of choanae, extending backwards; distance between ridges equal to transverse diameter of one ridge; palatal glands opening in sinuous discontinuous groove, between, but somewhat anterior, to choanae; tongue large, strongly

\* M. Smith has described a frog from the peninsular part of Thailand as *Rana cancrivora raja*. I do not believe the form to be a subspecies of *cancrivora*. Dunn (1928) has placed *verrucosa* also as a subspecies of *cancrivora*. This is a very doubtful relationship.



FIG. 34.—*Rana cancrivora* Gravenhorst. Upper figure, No. 34294 ♀. Ang Hin, Chon Buri. Actual snout-vent length, 68 mm. Lower figures, unnumbered, natural size, males, Ang Hin, Chon Buri, Thailand.

notched behind, free for three fourths of its length (no vocal slits or vocal sacs in males).

Skin above with numerous glandular warts, some forming elongated ridges others small tubercles; more or less conspicuous row of rounded tubercles border side. Skin of chin, venter, and underside of thighs smooth; some inconspicuous tubercles on posterior face of thigh; arm short, digits without webs, their tips swollen into small dilations; first finger slightly longer than second; subarticular tubercles distinct; two rather flat metacarpal tubercles scarcely distinguishable; toes perhaps three-fourths webbed; distinct skin-flap along outer toe; prominent inner metatarsal tubercle; no outer tubercle; subarticular tubercles well developed; limbs short, tibio-tarsal articulation reaching front edge of eye; when limbs are folded at right angles to body, heels touch.

*Color in life:* Above gray to brownish gray with irregular gray-black spots; spots on arms and legs; outermost row of small warts on sides, and gland at mouth-angle, cream; chin, venter, and concealed parts of arms and legs cream; undersurface of foot lavender, tips of toes and fingers cream; some fine diffuse pigment on chin.

*Measurements in mm.:* Snout to vent, 68; width of head (at tympanum), 27; length of head, 23; arm, 36; leg (from vent), 86.

*Variation:* The markings on the body vary considerably. Some individuals may be nearly uniformly colored; in others the spotting is strongly defined. Occasionally individuals are found in which the spots are arranged symmetrically. A chevron-shaped spot is almost always discernible in the supraorbital area and a transverse shoulder mark appears in many specimens.

*Distribution:* In Thailand the species is known to occur in Bangkok, Petriu (near Bangkok), Chon Buri, Songkhla, and Chumphon. Outside of Thailand the species is known in Malaya, the Indo-Australian Archipelago and has been reported as far east as the Philippines. It is probably rare in Malaya. There is a report of a specimen from Singapore.

*Remarks:* This species has strong tolerance for salt water. A large series was obtained on the beach at night at Ang Hin, from numerous tide pools at low tide. The frogs were feeding in these pools on crabs and other crustaceans. During the day-time the frogs were hidden among the rocks forming the foundation of a pier. There were fresh-water or brackish-water pools nearby, where the species laid eggs and the young developed. Some, but not all of these pools were well above the high tide mark.

*Rana limnocharis limnocharis* Gravenhorst

FIG. 35

*Rana limnocharis* Gravenhorst, Deliciae Musei Zoologici Vratislaviensis continens Chelonias et Batrachia, fasc. 1, Lipsiae, 1829, p. 42 (type locality, Java); Wiegmann, Nova Acta Acad. Leopoldina-Carolinae Ger. Nat. Curio., vol. 17, pt. 1, 1835, p. 255; Stoliczka, Proc. Asiat. Soc. Bengal, 1872, p. 102; Journ. Asiat. Soc. Bengal, vol. 42, 1873, p. 116; Flower, Proc. Zool. Soc. London, 1899, p. 893; Laidlaw, *ibid.*, 1900, p. 885; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903; Ferguson, *ibid.*, vol. 15, 1903, p. 502; Boulenger, Spolia Zeylanica, vol. 2, 1904, p. 73; Stejneger, Bull. U. S. Nat. Mus., Bull. 58, 1907, p. 127, figs.; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 236; Robinson and Kloss, Journ. Federated Malay States Mus., vol. 5, 1913-15, p. 155; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1916, pp. 165-166; *ibid.*, vol. 2, pt. 3, Dec. 1917, pp. 228-260; Annandale, Mem. Asiat. Soc. Bengal, vol. 6, 1917, p. 133, text figs. pl. 5, fig. 6; M. Smith, vol. 2, pt. 3, Dec. 1917, pp. 228, 265; Annandale, Mem. Asiat. Soc. Bengal, vol. 6, 1917, p. 133, fig. 2, pl. 6; Journ. Federated Malay States Mus., vol. 7, 1917, p. 108.

*Rana limnocharis limnocharis* Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, 1958, pp. 1051-1053, fig. 2.

*Rana gracilis* (*non* Gravenhorst) Wiegmann, Nova Acta Acad. Leop-Carol., vol. 17, pt. 1, 1835, p. 255; Günther, The reptiles of British India, 1864, p. 409; Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum, 1882, p. 28 (*part.*).

**Diagnosis:** Tips of digits slightly swollen, not or scarcely wider than digit; first finger extending beyond second; toes one-half to two-thirds webbed; outer metatarsals separated by a web; a compressed inner and a small outer metatarsal tubercle. Back with warts or numerous longitudinal glandular folds; vocal sacs, in male, black externally.

**Description of species** (from No. 82, Chiang Mai): Head rather low, the snout a pointed oval, about as long as orbit; canthus rostralis obtuse; interorbital space narrower than upper eyelid; loreal area oblique, area behind nostril concave; a tympanic fold crosses upper edge of tympanum which is approximately three fifths diameter of eye, separated from eye by a distance equal to three fifths its diameter.

Vomerine teeth on two oblique ridges beginning near inner anterior border of choanae at end of slight ridge that passes above choanae; openings of palatal glands in a curved row about midway between upper edge of vomerine ridges and front of palate (males with two external vocal sacs, opening into mouth through puckered slits back near angle of mouth); tongue moderate, free behind for a third of its length, and free on sides.

Arm short; fingers short, pointed at tips or with a very slight swelling, first finger longer than second; no lateral ridges or fringes on fingers; subarticular tubercles well-developed; three distinct palmar tubercles, median largest, outer very small; an indistinct



FIG. 35.—*Rana limnocharis limnocharis* Gravenhorst. EHT-HMS No. 31778 ♀, Phu Phan, Sakhon Nakhon, Thailand. Actual snout-vent length, 41 mm.



row of tubercles along outer face of forearm; (male with a large nuptial gland on first finger, extending from base to distal phalanx); legs moderate, tibiotarsal articulation reaching front level of eye; toes about three-fourths webbed (or less), their tips pointed or very slightly swollen; partial skin-fringe on outer side of fifth; somewhat compressed, anteriorly elevated, inner metatarsal tubercle and small outer; small tarsal fold; subarticular tubercles smaller than those on fingers; when legs are folded at right angles, heels overlap five millimeters or more.

Skin minutely granular with numerous longer and shorter glandular folds and pustular warts sometimes tending to form rows on sides; an area low on sides somewhat areolate; chin, breast, and most of venter smooth; posterior part of venter areolate as is much of the posterior half of undersurface of thigh and much of posterior face of thigh on sides of vent; an indistinct ventrolateral fold from axilla to groin, and an indistinct fold indicated across breast; small fold indicated from jaw angle across anterior point of insertion of arm.

*Color in life:* Above generally olive, variegated with darker, somewhat symmetrical markings; three dark bars on upper and lower lips; a canthal mark; an interrupted bar across orbital and inter-orbital areas; broad median orange-brown stripe from tip of snout to end of coccyx; spot covering upper part of tympanum, leaving a lighter diagonal bar from eye to jaw angle; lighter brownish diagonal bar from shoulder to groin, its anterior part a rounded brownish spot, posterior part in groin nearly yellow white; limbs barred with dark brown; chin, venter, and underside of limbs yellowish white to cream. (Males with black areas on chin over vocal sacs or entire chin may be black).

*Measurements in mm.* (Nos. 82 and 36344, Chiang Mai province): Snout to vent, 62, 42; width of head, 23, 18; length of head, 19, 13.2; arm, 30.3, 22.2; leg, 92.3, 61; tibia, 30, 20.2; foot and tarsus, 43, 30.

*Variation:* Owing to the fact that this species is ubiquitous in lowlands and numerous specimens are available from many localities, it is possible to discern geographic populations showing differences in size, in the general rugosity of the body and in color patterns, so that from a mixed lot it is often possible to separate them at sight. Thus a group from Kaeng Pang Tao northern Chiang Mai province have the tubercles and ridges more pronounced than elsewhere, none seemingly showing the median light stripe.

About Chiang Mai (city) a large proportion of the female speci-

mens have an orange-brown stripe and a dim diagonal lateral stripe beginning with a rounded brown spot. In the southeastern part of the country the specimens are gray and blackish often with a clay-colored median line (appearing usually in females).

The shape of the vomerine ridges, and their proximity to the choanae varies also. The males differ in having a diffuse gland over two sides of the venter. This comprises most of the venter, except posteriorly, the surface being closely covered with minute tubercles. The ventrolateral folds, and the sinuous fold across the breast together form a "ventral disc" evident on many Leptodactylid frogs, and not typical of *Rana*. A glandular patch is present on the front of the chin. A fold anterior to the breast marks the posterior limit of the vocal sacs. The area external to the sacs is deep black in all adult males. The ventral fold just in front of arm-insertion is often very distinct, occasionally not apparent if the arms are stretched backwards.

*Distribution:* The subspecies probably occurs in lowlands everywhere in Thailand. It ascends some distance into the mountains.

Outside of Thailand the species is very widespread in India, Ceylon, Formosa, China, and Japan. It occurs also in Malaya and the Indo-Australian Archipelago. The complete range of this, the presumed typical subspecies is still undefined.

*Remarks:* This small amphibian is significantly important in Thailand. It furnishes considerable food for human consumption and serves more than other amphibians as the chief food for certain animals. I believe it to be the major food for many of the terrestrial lowland snakes that utilize cold-blooded animals for food.

### *Rana macrodon* Kuhl, in Tschudi

FIG. 36

*Rana macrodon* Kuhl, in Tschudi, Mem. Soc. Sci. Neuchâtel, vol. 2, 1839, p. 80 (type locality, Java); Duméril and Bibron, *Erpétologie Générale* . . . vol. 8, 1841, pp. 382-384; Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 1882, p. 24, pl. 1, fig. 4; (*part.*); Flower (*part.*) Proc. Zool. Soc. London, Dec. 1, 1896, pp. 898-901, plate 45, fig. 1 (excellent figure in color of *Rana macrodon*); Laidlaw, Proc. Zool. Soc. London, 1900, p. 885 (*part.*); Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 233-234 (*part.*); M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 1, no. 2, 1915, p. 130; *ibid.*, vol. 1, no. 3, 1916, p. 156; *ibid.*, vol. 3, 1916, p. 165; van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, pp. 174-176 (*part.*); M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 98 (*part.*).

*Diagnosis:* Large frogs, differing from *Rana blythii* in having a relatively shorter head in proportion to length, tympanum separated from eye by a distance less than diameter of tympanum; snout



FIG. 36.—*Rana macrodon* Kuhl, in Tschudi. No. M. 41. Actual snout-vent length, 90 mm. Kuala Lumpur, Malaya.

shorter in front of level of nostrils; eye proportionally shorter; tibio-tarsal articulation to level of eye.

*Description of species* (from No. M 41, Kuala Lumpur): Head broad (43 mm.), not or but slightly greater than its length (39.6 mm.); canthus not or scarcely indicated, the loreal region strongly oblique, very shallowly concave; nostrils very much closer to mid-point on lip than to eye; width of an eyelid (7.9 mm.) slightly wider than interorbital distance (7.5 mm.); distance between nostrils five millimeters, nostrils narrow, slitlike; jaw forming a shelf below eye; tympanum large, diameter (7.2 mm.) greater than its distance from eye (5 mm.) and slightly less than eye length (8.9 mm.); an indistinct fold indicated across head behind eyes; a fold from edge of upper eyelid passes above tympanum, then extends down and terminates behind angle of jaw; vomerine teeth on two sharp ridges arising at anterior inner edge of choanae and extending diagonally backwards toward mid-line, to some distance beyond posterior level of choanae; strong transverse ridge behind choanae almost touching vomerine tooth ridges; no openings from palatal glands evident; no vocal sac or vocal openings; tongue elongate, broadened and notched behind, free for nearly half its length; pair of strong bony processes from ends of mandibles extending backwards and fitting into well-defined depressions in upper jaw when mouth is closed.

Arm moderate, fingers unwebbed without lateral ridges; sub-articular tubercles distinct, tips of fingers swollen, first finger much longer than second, reaching nearly as far as third; second and fourth equal; a prominent inner metacarpal tubercle, outer flat, scarcely discernible.

Leg short, tibiotarsal articulation reaches forward to a point two millimeters beyond eye; toes about four-fifths webbed, the web extending to swellings at tip as narrow fringes; an elongate metatarsal tubercle; subarticular tubercles distinct, no tarsal fold.

Skin above generally smooth over body and limbs; posterior half of eyelid with well-defined tubercles, one or two almost titlike; the sides with minute pavement-like granules with a few very indefinite tubercles dorsolaterally. Chin with a fine subcutaneous ridge, forming a fine reticulum; breast, venter, thigh, smooth but with fine vertical wrinkling and immediately posterior to vent fine vertical grooves.

*Color:* Above generally light brown with chocolate brown shading and indistinct markings including a darker chevron on shoul-

ders; a dark line follows the supratympanic fold; darker flecks on tympanum; some indistinct black spots along lower edge of upper jaw and upper edge of lower jaw. Throat, breast, and anterior part of venter light brown with fine flecking of cream.

Arms and legs with indistinct brown bars; back part of thighs blackish with some fine vermiform flecks and reticulations. A hair-fine median cream line from snout to end of rump and touching a similar fine transverse line running across back of femora. Under-side of foot dark chocolate.

*Measurements in mm.*: Snout to vent, 90; width of head, 43; length of head, 39.6; arm, 50; leg, 136; tibia, 45; foot and tarsus, 62.

*Distribution*: This species originally described from Java is known to occur also in the Malay Peninsula and has been reported from Thailand by Malcolm Smith and Flower.

This species and *Rana blythii* occur together and should not be regarded as subspecies.

### *Rana blythii* Boulenger

FIGS. 37, 38

*Rana fusca* Blyth, Journ. Asiat. Soc. Bengal, vol. 24, 1885, p. 719 (type locality?) (preoccupied); Stoliczka, *ibid.*, vol. 42, 1873, p. 115.

*Rana macrodon* Boulenger (*part.*), Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 1882, p. 21, pl. 1, fig. 4; Blanford, Proc. Zool. Soc. London, 1881, pp. 225-226, pl. 21, fig. 4, 4a; Flower, Proc. Zool. Soc. London, 1889, p. 888, pl. 59, figs. 1, 1a (tadpole); Laidlaw, Proc. Zool. Soc. London, 1900, p. 885, (*part.*); Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, 1958, pp. 1053-1054 (Nakhon Si Thammarat).

*Rana blythii* Boulenger, Rec. Ind. Mus., vol. 20, 1920, pp. 40, 43-45 (new name for *Rana fusca* [non Meyer] Blyth); van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, pp. 174-176 (*part.*).

*Diagnosis*: Very large frogs reaching a length of nearly 260 mm. snout to vent. Tips of digits swollen or somewhat dilated, without peripheral groove; outer metatarsal separated by web for all or most of its length; dorsolateral fold absent; no vocal sacs; no nuptial pad on first finger, which is much longer than second; tympanum distinct, widely separated from eye by a distance much more than its diameter; male lacking vocal sacs; large toothlike bony projections from front of lower jaw of males (very low in females); eye large; a rather distinct canthus rostralis and oblique loreal region.

*Description of species* (from No. 151, Na Bon, Nakhon Si Thammarat): Head oval, longer than wide; canthus rostralis not distinguishable; loreal region very oblique, somewhat concave, nostril nearer tip of snout than to eye; upper eyelid wider than interorbital



space; tympanum distinct, its greatest diameter about three fifths of length of eye, separated from eye by a distance considerably greater than its diameter. Snout longer than eye; a supratympanic fold curving down behind tympanum to above arm.

Choanae posteriorly placed in palate; pair of elongate oblique ridges bearing vomerine teeth begin near inner anterior edge of choanae but separated by distance equal to less than one fourth of

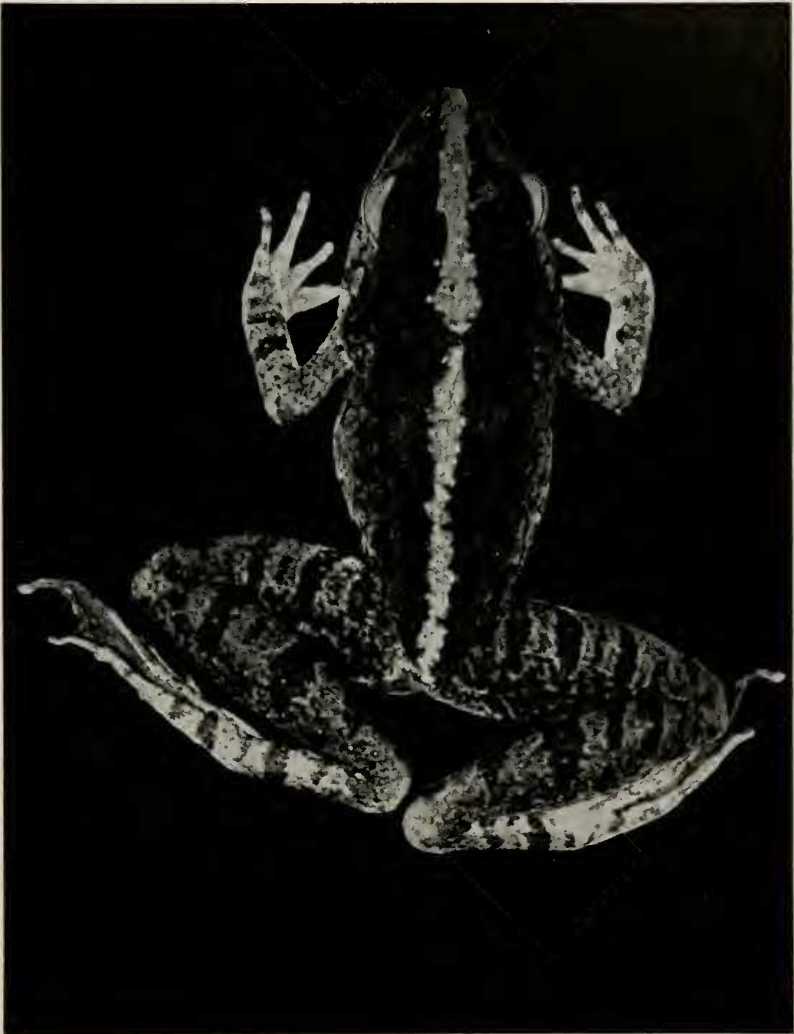


FIG. 37.—*Rana blythii* Boulenger. No. 34546. Actual snout-vent length, 228; La Doo Tin Mine, Yala, Thailand.

their length and converge toward median line considerably behind choanae; palatal glands open into mouth through several separate openings midway between front of palate and anterior level of choanae; tongue large, prominently notched behind. Arms and legs moderately long, finger tips swollen, scarcely as wide as finger; first finger much longer than second; subarticular tubercles moderately large; lateral fleshy ridge on sides of third finger and a short one on second; three palmar (metacarpal) tubercles, the two outer flat, more or less fused together; leg with tibiotarsal articulation reaching nostril; foot completely webbed; digit tips dilated; inner metatarsal tubercle somewhat compressed, elongate, more than half length of first toe beyond tubercle; no outer tubercle; subarticular tubercles large; a prominent skinfold on outer side of fifth toe; a tarsal fold.

Skin generally smooth (under lens minutely corrugated); a few small scattered pearl-tipped tubercles on legs; chin, venter, as well as undersurface of limbs, smooth; granules in area about vent scarcely discernible.

*Color:* Head, dorsum, and sides blackish brown with narrow cream median line from end of coccyx to tip of snout; upper and lower lip with large black spots, those on lower jaw bordered by yellow; limbs brownish with large black bands; back of thigh with a transverse hair-fine cream line; below this, thigh brownish, reticulated with cream; chin, venter, and underside of limbs whitish or yellowish white with shadowy dark spots on front of breast; dark lavender on palms of hands and soles of feet.

*Measurements in mm.* (No. 151, and No. 34546): Snout to vent,\* 110, 228; width of head, 40, 90; length of head, 41, 85; arm, 54, 102; leg, 180, 339; tibia, 58, 113; foot and tarsus, 75, 152.

*Variation:* The second specimen measured, No. 34546, from Bhetong, Yala, is very large, but still falls short of the maximum size. One larger specimen in the collection not at the moment available, is approximately an inch longer, and specimens still larger have been reported.

In color the specimen is dark brown, nearly uniform, somewhat lighter laterally. The banding on the limbs can be seen if the specimen is submerged in clear liquid. The entire chin and breast is smoky brown, the spots on lower lips blackish. The venter and underside of limbs are dirty whitish; undersurface of hands and feet dark lavender.

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\* In most cases the vent is terminal or nearly so; measurement is made on mid-line to posterior median part of thigh when this extends beyond vent.



FIG. 38.—*Rana blythii* Boulenger. No. 151. Actual snout-vent length, 110;  
Na Bon, Nakhon Si Thammarat, Thailand.

The tympanic region as well as tympanum concave, overhung by a fold from eye to arm; a distinct fold across head at level of the posterior edge of orbits. The eyelid (16 mm.) much narrower than interorbital distance (22 mm.).

A series of young specimens taken on a small mountain near Haadjai, Songkhla, 52 to 71 mm. in length have the head and dorsum finely and distinctly granular intermixed with tubercles and small warts. Most of the series have a broad orange stripe. Below, the specimens were uniform yellowish. These were perched on rocks near pools in a rivulet at an elevation of about 300 meters.

Another series from Kuala Lumpur are somewhat lighter olive in color, the eyes averaging a little larger.

*Distribution:* While it is difficult to be certain from the literature descriptions of *Rana macrodon* which species is involved, it appears fairly certain that both *macrodon* and *blythii* are included in the materials collected by Dr. Malcolm Smith in southern Thailand. I have taken only *blythii*.

### *Rana doriae* Boulenger

FIG. 39

*Rana doriae* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 5, 1887, pp. 482-483, pl. 8, fig. 1 (type locality, Tenasserim); Anderson, Journ. Linn. Soc., Zool., vol. 21, 1889, pp. 336, 349; Boulenger, The fauna of British India, including Ceylon and Burma; Reptilia and Batrachia, 1890, pp. 447-448; Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, pp. 328-329, pl. 8, fig. 1, 1a; Butler, Journ. Nat. Hist. Soc. Bombay, vol. 15, 1904, p. 196; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 231; M. Smith and Kloss, Journ. Nat. Hist. Soc., Siam, vol. 1, no. 4, Dec. 1915, p. 249 (S. E. Siam, Koh Chang, Koh Mehsi, Koh Kut); *ibid.*, vol. 2, no. 2, Dec. 1916, p. 165 (Khao Wang Hip, Nakhon Si Thammarat province); Annandale, Mem. Asiat. Soc. Bengal, vol. 6, 1917, p. 133; Boulenger, Rec. Ind. Mus., vol. 20, 1920, p. 49; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 3, no. 3, May 1917, p. 228; *ibid.*, vol. 4, no. 4, Jan. 25, 1922, pp. 217-218, pl. 9, fig. 1; Bull. Raffles Mus., no. 3, 1930, p. 98.

*Diagnosis:* Head in males without toothlike projections in lower jaw; no flap or knoblike prominence in interorbital or occipital regions, but this area convex in males; tympanum in males varies; in some its diameter equals eye-length, in others only three fourths of eye-length; fingers and toes with small discs; no vocal sac in male. Head normal in females, somewhat enlarged in old males.

*Description of species:* Canthus rostralis distinct but rounded; interorbital space as wide as an upper eyelid, the region in males convex; tympanum distinct, its diameter three fourths to full diameter of eye, largest in adult males; vomerine teeth in two diagonal fasciculi beginning near posterior edge of choanae and extending back; lower jaw without toothlike prominence from near symphysis.



FIG. 39.—*Rana doriae* Boulenger. After Boulenger, pl. 8, fig. 1, Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1892-93. Actual length, approximately 57 mm. Palon, Karin Hills, Burma.



Fingers and arms moderate, first finger longer than second, tips dilated into small discs; toes more than four-fifths webbed; tips of toes with small discs wider than those on fingers; subarticular tubercles moderately large; fringe on outer side of outer toe; an elongate inner metatarsal tubercle two thirds length of inner toe; no outer metatarsal tubercle; indistinct tarsal fold; leg moderately long, heel reaching to near nostril; top of head and occipital region smooth; back with longer or shorter glandular tubercles; an indistinct fold between posterior corners of eyes; a fold beginning behind eye runs above tympanum to near arm-insertion.

Skin smooth or with irregular glandules on back; a more or less distinct fold across head behind upper eyelids; a strong glandular fold from eye to shoulders.

*Color:* Above olive-brown to dark-brown with more or less symmetrical darker markings bordering slightly swollen area on occiput; W-shaped mark on shoulders; snout lighter with a dark band between eyes; upper thigh, tibia, tarsus, and foot strongly barred with dark blackish-brown; back of thigh, dark, reticulated with yellow; lip with vertically placed dark-brown bars; yellowish white beneath, on chin, venter, and concealed parts of limbs, in females (chin and throat of males dark, marbled with blackish brown).

*Measurements in mm.* (from M. Smith No. 5922): Snout to vent, 50 mm., length of head, 18; width of head, 19; snout, 8; eye, 5; inter-orbital width, 4; tympanum, 4; arm, 26; leg, 80; tibia, 27; foot, 25.

*Variation:* The sexual variation in this form is somewhat less than in related forms, since the head of the male does not become greatly enlarged and there are no toothlike projections from the front of the lower jaws. There is no vocal sac in the male; no occipital swellings developed.

The tibiotarsal articulation may reach as far as the tip of the snout or may extend somewhat beyond this point. The form that occurs on the Andaman Islands differs in numerous particulars. The vomerine teeth are farther forward, the web between toes more emarginate, and a distinct outer metatarsal tubercle is present.

Males have the throat spotted or marbled with brown.

*Distribution:* The species is known only in the peninsular part of Thailand, specimens having been taken in Prachaup Khiri Khan, and Chumphon provinces. The species is known also in Tenasserim, Burma, and it has been taken in Malaya.

*Rana kohchangae* M. Smith

FIG. 40

*Rana doriae* Smith and Kloss, Journ. Nat. Hist. Soc. Siam, vol. 1, Dec., 1915, p. 249.

*Rana macrognathus* (part.) Boulenger, Rec. Ind. Mus., vol. 20, 1920, p. 51.

*Rana kohchangae* Smith, Journ. Nat. Hist. Soc. Siam, vol. 4, no. 4, July 25, 1922, pp. 223-225, pl. 9, fig. 5 (type locality, Koh Chang, Gulf of Siam).

*Diagnosis:* The least-modified member of the *Rana doriae* group. Head somewhat enlarged with a pair of fanglike bony processes on front of lower jaws; canthus rostralis obtuse; distance between nostrils greater than interorbital width which is greater than width of upper eyelid. First finger as long as second; one metatarsal tubercles; well-marked tarsal fold; no flap in interorbital or occipital area; latter region not or but slightly swollen.

*Description of species* (from M. S. No. 6055. Koh Chang I. EHT-HMS 29857): Head moderate, broader than long, snout oval rather pointed; canthus rostralis obtuse, loreal region somewhat concave; nostril nearer tip of snout than to eye; interorbital width greater than that of upper eyelid; tympanum distinct, its diameter three fifths of eye length, separated from eye by distance equal to two thirds its diameter; strong fold from eye, curves back above tympanum and down to arm-insertion; snout projecting slightly beyond mouth; vomerine teeth on two oblique subtriangular ridges beginning near inner sides of choanae but extending much behind their posterior level, narrowly separated mesially, each ridge larger than a choanal opening; palatal glands open in a transverse series at upper level of choanae; tongue free for nearly half its length (male with internal vocal sac; a pair of fanglike triangular bony projections from lower jaws).

Arms short, first finger as long as second; three metacarpal (palmar) tubercles; subarticular tubercles, strongly developed; some traces of lateral ridges on inner digits; tips swollen into small discs; leg moderate, tibiotarsal articulation reaching to anterior edge of eye; when legs are folded at right angles heels overlap a little; toes almost completely webbed, tips dilated into discs each with a peripheral groove; strongly compressed inner metatarsal tubercle, nearly half length of inner toe; no outer metatarsal tubercle.

Skin above with numerous short folds or rounded tubercles scattered rather regularly on back; supratympanic fold; two diagonal folds on shoulder; arms and legs with scattered tubercles; chin venter and underside of limbs smooth, except ventroposterior face



FIG. 40.—*Rana kochangae* M. Smith, EHT-HMS No. 29857 ♀.  
Actual snout-vent length, 35 mm. Koh Chang I, Gulf of Siam.

of thigh and region on both sides of vent covered with more or less regular granules; well-defined tarsal fold.

*Color:* Above generally olive-brown with some lighter and darker markings usually along short glandular folds; arms and legs barred with brown; lips with brown spots; all lower surfaces yellowish white.

*Measurements in mm.:* Snout to vent, 35; width of head, 16; length of head, 14.6; arm, 21.5; leg (from vent), 57; tibia, 18; foot and tarsus, 26.

*Variation:* Malcolm Smith reports that the tibiotarsal articulation may reach as far as nostril, and that the tympanum (presumably) of males may equal area of eye; the first finger may be slightly longer than second. Rarely a broad yellow stripe is present. The maximum (snout-vent) size is about 42 millimeters.

*Distribution:* The species has been found on Koh Chang, Koh Kut and Koh Mehsi and on the mainland at Ok Yam.

It is not known elsewhere.

*Remarks:* It has been pointed out by Smith that it is practically impossible to separate the females of this group of species since, the specific differences are to be found in secondary sexual characters of the males. One might suppose that the relations are more of a subspecific than specific nature. However in several places two distinct forms have been found occurring together, each maintaining its own characters. In the case of *kohchangae* its occurrence on the mainland suggests that it may occupy the same territory as *Rana pileata* known to occur only 125 kilometers from Ok Yam. These frogs are usually encountered along small streams.

### *Rana macrognathus macrognathus* Boulenger

FIG. 41

*Rana macrognathus* Boulenger, Ann. Mag. Nat. Hist., ser. 8, vol. 20, 1917, p. 414 (type locality, Karen Hills, Burma); Rec. Ind. Mus., vol. 20, 1920, p. 51; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 4, 1922, pp. 216, 218, pl. 9, fig. 2; M. Smith, Bull. Raffles Mus., no. 3, 1930, pp. 98-99; Boulenger, Rec. Ind. Mus., vol. 20, 1920, p. 51; Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, 1958, p. 1039, fig. 3.

*Diagnosis:* \* A small *Rana*, males reaching a length of 40 mm.; head enlarged; swelling on occipital region and low swelling just back of interorbital area but without free flap; tympanum as large as or larger than eye; head thickened posteriorly; jaws swollen; skin

\* Malcolm Smith (1922) calls attention to the confusion formerly existing in Boulenger's descriptions of certain species of this group. This has been corrected by Boulenger (1920). In this same paper Smith corrects further listings made by Boulenger in his monograph on South Asian Ranae.

below jaw somewhat plicate; tibiotarsal articulation to tip of snout; arms short, first finger longer than second; lower jaw with two distinct toothlike projections; tips of digits with distinct discs; toes about four-fifths webbed.

*Description of species* (from M. S. No. 6330. Nakhon Si Thammarat): Head enlarged, canthus somewhat rounded; loreal region concave, oblique; snout scarcely extending beyond mouth; nostril



FIG. 41.—*Rana macrognathus macrognathus* Boulenger. No. 215. Actual snout-vent length, 50 mm. ♂, Na Bon, Nakhon Si Thammarat, Thailand.



nearer tip of snout than to eye; upper eyelid considerably narrower than interorbital distance; tympanum distinct, large, its area equal or greater than eye, separated from eye by distance equal to half its diameter; vomerine teeth on two sharply elevated ridges that arise about level of middle of choanae and extend behind their posterior level, separated mesially by distance equal to about half length of one ridge; choanae visible from below; tongue free posteriorly for little more than a fourth of its length, and free on sides; no vocal sac or slits.

Skin on head and dorsum relatively smooth with few small warts on sides and on rump; under lens one sees occipital swollen area covered with minute regular granulations not present on slight interorbital swelling; no free skin-flap; narrow fold from eye passes above tympanum to arm-insertion; few small warts on upper eyelid; legs with few elongate, narrow ridges; granules on back of thigh and area about vent; chin and venter smooth; few narrow elongate folds on dorsum.

Arm short, fingers slightly swollen at tips; first finger longer than second; subarticular tubercles distinct; three palmar (metacarpal) tubercles, median smallest; narrow ridges of skin along inner sides of middle digits. Toes almost completely webbed; tips of digits widened into small but distinct discs; an elongate somewhat compressed inner metatarsal tubercle more than half as long as first toe; no outer tubercle; distinct tarsal fold; when legs are folded at right angles to body heels overlap five millimeters; tibiotarsal articulation reaches tip of snout.

*Color in life:* Olivaceous green or brown above with darker markings; throat white; belly and under surface of thighs pale yellow, the two colors usually clearly limited by fold across throat; lips and limbs with dark bars and pale narrow band between eyes; broad yellow stripe from median tip of snout to vent, its sides darker brown, indistinct lateral yellowish mark with brown spots both above and below it.

*Measurements in mm.:* Snout to vent, 55; width of head at tympanum, 26; length of head, 28; arm, 28; leg, from vent, 88; tibia, 30; foot and tarsus, 35; diameter of tympanum, 7.5; length of eye, 6.

*Variation:* Age variations are rather striking and the sexual variation is greater than in most frogs. In females the head does not become enlarged and the swelling in the occipital and interorbital regions is lacking. There may or may not be a median dorsal light line, and this may vary in width when present. In the specimen figured, the mouth is actually small.

*Distribution:* The species originally described from the Karen Hills of Burma has been traced south into the northern part of the Malay Peninsula to the mountains of Nakhon Si Thammarat.

Smith (1930) reports specimens from De Lisle Island and Pulo Rawi off the coast of peninsular Thailand and from the Me Taw forest of West Raheng.

### *Rana pileata* Boulenger

FIG. 42

*Rana pileata* Boulenger, Journ. Nat. Hist. Soc. Siam, vol. 2, 1916, pp. 103-105, pl. —, figs. A to E (type locality, "Khao Cebab, Chantabun" = Chanthaburi province, Thailand); M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 3, 1917, p. 228; Boulenger, Rec. Ind. Mus., 1920, vol. 20, pp. 52-53; Rao, Journ. Bombay Nat. Hist. Soc., vol. 27, 1920, p. 119; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 4, no. 4, July 25, 1922, pp. 222-223, pl. 9, fig. 4; Bourret, Annexe au Bull. Pub. Inst. no. 7, 1939, p. 58; Les Batraciens de l'Indochine, 1942, pp. 268-270, fig. 69.

*Rana macroglypta macroglypta* Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, no. 13, Mar. 20, 1958, pp. 1054-1056, fig. 3 (*part.*).

*Diagnosis:* Strong sexual dimorphism. Adult males with heads swollen, jaws expanded, interorbital and part of postorbital area with median tongue-like flap, free-edged behind; no canthus rostralis; eye smaller than tympanum which is separated from eye by distance equal to length of eye; tibiotarsal articulation reaches to near nostril; foot three-fourths webbed, tips of toes dilated into small but distinct terminal discs; first finger longer than second; two small tooth-like processes from front of lower jaws; heel to front of eye.

*Description of species* (from No. 34951, Phu Kading, Loei province): Head distinctly wider than body, wider than long; snout oval seen from above; no distinct canthus rostralis; loreal region sloping obliquely to lip; not concave; nostril nearer tip of snout than to eye; lips, loreal region, and top of head glassy smooth; flap on head extending six millimeters behind level of eyes; width of upper eyelid (4 mm.) contained twice in interorbital distance (8 mm.); tympanum large, distinct, its diameter a fifth longer than eye; a strong fold beginning behind eye passes above tympanum then turns down to point above arm-insertion; occipital area swollen on each side; tympanum separated from eye by distance greater than length of eye.

Tongue notched behind, free for half its length, free laterally; vomerine teeth on two elevated ridges lying between and largely behind level of choanae, separated by a distance equal to their distance from choanae; pair of tooth-like processes in front part of



FIG. 42.—*Rana pileata* Boulenger. No. 36569 ♂. Actual snout-vent length, 57.5 mm. Doi Pna Kao near Mt. Inthanon, Chiang Mai, Thailand.

lower jaw; choanae as large as openings to Eustachian tubes; no vocal sac (males). Palatal groove nearer anterior level of choanae than to front of palate.

Arm short, first finger as long as, or a little longer than second; three distinct palmar tubercles; tips of fingers swollen a little, wider than digits; subarticular tubercles strong. Leg long, tibio-tarsal joint reaching to or near to nostril; foot three-fourths to four-fifths webbed; tips of toes dilated into small but distinct discs; web reaching terminal disc on inside of toe, but rather deeply excised; subarticular tubercles present; an elongate, somewhat bean-

shaped, inner metatarsal tubercle; no outer; a free flap of skin along outer toe; outer metatarsals separated from others by web; a small tarsal fold; no outer metatarsal tubercle.

Skin on head smooth; back with numerous irregular warts; skin low on sides, on chin, venter, and on greater part of undersurface of thigh smooth; posterior part of thigh finely granular; leg with fine tubercles intermixed with larger tubercles, many of which are pearl-tipped.

*Color:* Dark dull-olive growing somewhat brown on rump and lighter on limbs; chin gray; breast and venter white; underside of thigh white; underside of foot and tarsus plumbeous; arm and leg dimly barred with darker.

*Measurements in mm.* (of Nos. 34951 and 34959, respectively): Snout to vent, 60, 51; width of head, 31, 27; length of head, 28, 23; arm, 37, 30; leg, 96, 81; tibia, 31, 27; tarsus and foot, 43.5, 37.

*Variation:* In females the differences are considerable, since they lack the fanglike processes in lower jaw, their heads are not swollen, and the jaws are not widened. The interorbital region is narrower, only a little broader than an eyelid, and the head-flap is absent. The tympanum is three fourths to four fifths the diameter of the eye. Young males have only a small flap or a semicircular fold indicated.

The color of the females and young vary considerably. They may be olive or brown above, rarely green, with irregular mottling or spotting. A yellow band, dark-edged behind, may be present between the eyes; the lips are black spotted with lighter areas between spots. Below pale yellow, immaculate, or rarely with spots on the throat. Rarely a middorsal cream line is present.

It is difficult to distinguish the females of the various species of this *doria* group, which includes *doria*, *pileata*, *macrognotha*, *kohchangae*, and *toumenoffi*, etc. They are very similar indeed. The males, however, are easily differentiated.

*Distribution:* This species is not uncommon in southeastern Thailand at the type locality, Khao Seabab, and at Hup Bon, Siracha, in Chanthaburi province. In northern Thailand it has been taken at Doi Suthep, Doi Pna Kao (Amphur Cawm Tawng 7200 ft.), Camp Mae Ka (Stream, Amphur Mong Hawt, circa 4200 ft.), Whey Tat (Amphur Chiang Dao, elev. circa 6000), all in the province of Chiang Mai; Phu Kading, Loei province; Phu Phan (Mt.), Sakhon Nakhon; Nong Bua Lumpoo, Udorn Thani; Khao Pleung, Uttaradit; and the Me Song Forest, Phrae.

Outside of Thailand there are no records available to me.

*Remarks:* This species is the most strikingly modified species of the *doriae* group. The females, however, except on the basis of size can only be doubtfully separated from females of other members of the group.

The widening and thickening of the head is strictly an adult character. Malcolm Smith (1922) points out that the age at which the head of the male reaches maximum development is not always commensurate with the size of the frog. In my collection a specimen 66 millimeters in length has the head much as occurs in females save for the small flap, while in No. 36566, 50.5 mm. in length, the head is much thickened and widened and the flap is larger with two considerable swellings on the occipital area. This variation in size at which this flap develops caused Taylor and Elbel to consider one of the large immature specimen of *pileata* to be a *Rana macrognathus*.

*Rana pileata* is a hill and mountain species, occurring from 100 to above 2000 meters elevation.

### *Rana plicatella* Stoliczka

FIGS. 43, 44

*Rana plicatella* Stoliczka, Journ. Asiat. Soc. Bengal. vol. 42, 1883, p. 116, pl. 11, fig. 1 (type locality, Penang or Province Wellesley); Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata . . . 1882, p. 26; Flower, Proc. Zool. Soc. London, 1899, p. 890; Laidlaw, Proc. Zool. Soc. London, 1900, p. 885; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 196; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 231-232; Rec. Ind. Mus., vol. 20, 1920, pp. 53-54; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 4, no. 4. Jan. 25, 1922, pp. 227-228, fig. (head of *plicatella*).

*Diagnosis:* A member of the *Rana doriae* group. A strong fold across head behind eyes; about eleven elongate glandular ridges covering back; pair of fanglike processes arising from front part of lower jaws (not distinct in female or young); toes about two-fifths webbed; first finger longer than second; elongate, oblique vomerine tooth elevations beginning on inner posterior edge of choanae and extending considerably behind their back level; discs on toes small but distinctly widened; no vocal sac; maximum length, about 43 mm.

*Description of species* (from No. 34717, 15 km. NE Bhetong, Yala province): Snout oval seen from above; top of head rather flattened; nostrils far apart, distance between them one and one-half times interorbital width; canthus rostralis barely indicated; loreal region slightly concave, sloping obliquely to lip; snout longer than eye; length of eye greater than its distance to nostril; tympanum distinct,





FIG. 45.—*Rana plicatella* Stoliczka. No. 34717 ♀. Actual snout-vent length, 26. 15 km. NE Bhetong, Yala, Thailand.

little more than half diameter of eye. A strong skinfold curving from above arm-insertion across head close behind eyes; no distinct supratympanic fold.

Tongue notched behind, free behind for about one third of its length, also free on sides; vomerine teeth in two oblique elevated ridges beginning near inner posterior part of choanae, separated from each other by distance equal to their distance from choanae. Seen from directly below the choanae partially concealed by maxillary shelf.

Arm moderate, tips of fingers only slightly widened; first finger longer than second; subarticular tubercles well developed; leg long, tibiotarsal articulation reaches three millimeters beyond tip of snout; when leg is folded, heels overlap nearly three millimeters; toes approximately two-fifths to one-half webbed; tips dilated into moderately enlarged discs; narrow elongate inner metatarsal tubercle from



FIG. 44.—*Rana plicatella* Stoliczka. EHT-HMS No. 30249 ♂. Actual snout-vent length, 34 mm. Kuala Lumpur, Malaya.

which continues a well-defined tarsal fold; unwebbed part of toes with narrow fringes to discs; no, or at most, only a very indistinct outer metatarsal tubercle.

Skin smooth on top and sides of head; dorsum heavily lineated with ten to twelve, often discontinuous, longitudinal folds; no dorso-lateral fold discernible; sides with indistinct small tubercles; venter, chin, and underside of limbs smooth; posterior part of thigh granular; dorsum with warts and tubercles.

The discs on toes show a thin anterior edge, usually dark in color.

*Color in life:* Above variegated olive to olive-brown; large area on top of head gray-brown bordered laterally by dark line from snout to eye; supraorbital area black; row of indefinite irregular marks across shoulders, with dorsolateral series of irregular cream marks; arm barred with dark and light; thigh with three brown-black bars with other less distinct bars between them; edge of tibia and tarsus with black bars or spots; chin, venter, and underside of thighs ivory white; under surface of feet nearly black; back of thigh flecked minutely with brown (nearly uniform).

*Measurements in mm.* (from Nos. 34717, and 30249, Kuala Lumpur, Malaya): Snout to vent, 26, 34; width of head, 11.2, 15.8; length of head, 11, 15.2; arm, 18, 20; leg, 49.5, 59; tibia, 16, 19; foot and tarsus, 22, 25.

*Variation:* The adult differs from the described specimen in having a proportionally larger head, especially in males. The canthus is rounded and just back of the interorbital space is a small knoblike prominence or projection. The width of an upper eyelid is less than the interorbital width. The tympanum is distinct, its diameter equal to or larger than length of eye.

Two fanglike prominence arise from front of jaws in males. The upper eyelid is tubercular and a strong supratympanic fold is present. The interorbital area may be somewhat convex.

*Distribution:* The species has been taken in Thailand about 15 km. northeast of Bhetong, and at the La Doo Tin Mine, Benang Stah. Both localities are in Yala province.

In Malaya specimens are known from Penang, Perak, Selangor and Singapore. It has been found up to 4000 ft. elevation.

*Remarks:* Of the two specimens whose measurements are given only the one described was found in Thailand. It is, I believe, the first record for the country. It was taken along a small rivulet in low mountains in the southern part of the province of Yala, about

15 kilometers northeast of Bhetong. It was routed out from under leaves near the edge of a stream. The Malayan specimen was taken by me near the Batu Caves in Selangor. The latter is an adult male.

The specimen from the La Doo Mine came from an elevation of about 3200 feet. I found it ensconced under a slab of fallen bark near a small, slow-flowing stream.

The largest male specimens reach a length of 43 mm. Malcolm Smith reports a female specimen from Selangor, 29 mm. in length, with ripe ova. Tadpoles were taken in June.

### *Rana laticeps* Boulenger

FIG. 45

*Rana laticeps* Boulenger Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 1882, p. 20, pl. 1, fig. 1 (type locality Khassya, India); The fauna of British India, Ceylon and Burma; Reptilia and Batrachia, 1890, p. 444; Flower, Proc. Zool. Soc., London, 1896, p. 897; *ibid.*, 1899, p. 888; Butler, *ibid.*, 1902, p. 190; Boulenger, Fasciculi Malayenses, Zoology, vol. 1, 1903, p. 172; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 196; Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 23; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 230; Rec. Ind. Mus., vol. 20, p. 67; M. Smith, Journ. Federated Malay States Mus., vol. 10, 1927, p. 271 (Wray's Camp, Tahan River; Fraser's Hill, Malaya); Journ. Sarawak Mus., vol. 3, 1925, p. 18 (Borneo); Bull. Raffles Mus., no. 3, 1930, pp. 93, 98; *ibid.*, no. 10, 1935, p. 62; Bourret, Les Batraciens de l'Indochine, 1942, pp. 282-284, fig. 76.

**Diagnosis:** A small frog (40 mm.); strong fold across head behind eye; dorsal skin with numerous short ridges; fold from eye to shoulder; tympanum hidden; first finger longer than second; skin strongly wrinkled longitudinally; venter glassy smooth; heel reaches to midway between eye and nostril; strongly developed toothlike projections on lower jaws; vomerine tooth ridges oblique, extending considerably behind choanae, and scarcely separated mesially.

**Description of species** (from No. 34720. 18 km. NE Bhetong, Yala province): Snout oval, moderately pointed; canthus rostralis scarcely evident; loreal region oblique, somewhat concave behind nostril; tympanum hidden completely; a skinfold beginning near angle of mouth runs across head behind orbits; interorbital space little wider than an eyelid; pair of strongly developed toothlike processes in mouth arising from near symphysis of jaw; choanae small, the vomerine teeth on two elongate ridges extending obliquely from back edge of choanae, almost meeting on midline of palate at point considerably behind choanae.

Arm moderate, first finger equal or a little longer than second; subarticular tubercles well developed, metacarpal tubercles not well



FIG. 45.—*Rana laticeps* Boulenger. Upper figure, No. 34732 yg. Actual snout-vent length, 20.5 mm. Lower figure, No. 34720 ♂. Length, 35 mm. Both from near Bhetong, Yala, Thailand.



defined; fingers moderately long, first slightly shorter than second, discs moderately large; leg moderate, tibiotarsal joint reaching nearly midway between eye and nostril; when legs are folded, heels overlap four millimeters; toes little less than half webbed, inner with short web; digits dilated into small discs larger than those on fingers; elongate inner metatarsal tubercle; distinct tarsal fold.

Skin of head dorsally and laterally with very fine ridges and corrugations; few pustules on posterior part of back; skin on chin strongly wrinkled, with a slight fold across breast; venter glassy smooth as is entire underside of thigh and region about vent; very dim fold from eye to arm-insertion.

*Color in life:* Above fawn to light tan with brown markings on upper jaw, smaller ones on lower jaw; small brown line follows canthus; brown band between eyes; a W-shaped mark on shoulders and dorsolateral series of irregular brown marks; two bands of brown on thigh, tibia, and tarsus; chin yellowish, with brown flecks; venter flesh-white; fine flecking on underside of thigh and other concealed parts of limbs.

*Measurements in mm.:* Snout to vent, 35; axilla to groin, 13; width of head, 18; length of head, 16; arm, 20; leg, 60; tibia, 19; foot and tarsus, 23.

*Variation:* Considerable differences in the color pattern obtains. The smaller specimen figured has much less marking than the female pictured below. The male has no vocal sac. There is a conspicuous nuptial pad on the first finger.

*Distribution:* In Thailand the species has been collected in Chumphon and Yala provinces (and at Mamoh, near the Isthmus of Kra). Outside of Thailand it is known in the Malay States of Selangor, Malacca, Pahang, and Perak; also in Burma, Bengal and Borneo.

*Remarks:* The species has been found chiefly along small rivulets. At night it sits in shallow water or forages there for food. When approached it is likely to remain motionless rather than to attempt escape.

In the daytime it is usually found under stones at the edge of small rivulets. When disturbed it usually makes one leap into the shallow water then remains motionless in the water where it is easy to capture it.

*Rana kuhlii* Schlegel, in Duméril and Bibron

FIGS. 46, 47

*Rana kuhlii* Schlegel in Duméril and Bibron, *Erpétologie générale* . . . vol. 8, 1841, p. 384 (type locality, Java); Günther (*part.*), *Catalogue of the Batrachia Salientia* . . . of the British Museum, 1858 (1859), p. 8, var. A & C; *Reptiles of British India*, 1864, p. 404, pl. 26, fig. A (but not fig. B); Boulenger, *Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum*, 1882, p. 20; *Ann. Mus. Civ. Genova*, ser. 2, vol. 5, 1887, p. 482; *The fauna of British India Ceylon and Burma; Reptilia and Batrachia*, 1890, p. 443; Flower, *Proc. Zool. Soc. London*, 1899, p. 887; Boulenger, *ibid.*, 1899, p. 166; *Journ. Bombay Nat. Hist. Soc.* vol. 15, 1903, p. 195; *A vertebrate fauna of the Malay Peninsula* . . . *Reptilia and Batrachia*, 1912, pp. 229-230; M. Smith, *Journ. Nat. Hist. Soc. Siam*, vol. 2, no. 2, 1917, p. 227; *ibid.*, no. 4, Dec. 1917, pp. 262-263, pl.-fig. 1; Boulenger, *Rec. Ind. Mus.*, vol. 20, 1920, pp. 62-66; M. Smith, *Bull. Raffles Mus.*, no. 3, 1930, pp. 97-98; Taylor and Elbel, *Univ. Kansas Sci. Bull.*, vol. 38, pt. 2, Mar. 20, 1958, pp. 1057-1058, fig. 4 (Loei province); Bourret, *Les Batraciens de l'Indochine*, 1942, pp. 278-282, fig. 74.

*Rana corrugata* Taylor, *Proc. Acad. Nat. Sci. Philadelphia*, vol. 86, June 13, 1934, pp. 281-282 (Chiang Mai province).

*Diagnosis:* A very aquatic frog found usually along rivulets in hills and mountains; strong sexual dimorphism, males with very broad heads, lacking vocal sac and toothlike prominences on lower jaws; no canthus rostralis; tympanum hidden; first and second fingers equal; tibiotarsal articulation reaching to near eye; dark bar across interorbital area, light-bordered behind.

*Description of species* (from No. 33933 Doi Suthep, 1000 m. elev., Chiang Mai): Adult male with head greatly widened, its width exceeding its length; canthus rostralis indicated, loreal area oblique, somewhat concave; jaw much thickened; distance between nostrils about equal to interorbital width; upper eyelid equal to or a little wider than interorbital width; tympanum not visible; fold from eye curving back behind jaw-angle to near insertion-point of arm; jaw forming small shelf below eye; occipital area somewhat swollen; nostril about equidistant between eye and tip of snout; eye length less than snout length.

Vomerine teeth on two small diagonal ridges, each somewhat smaller than choana, beginning near inner edge, but extending for most part behind posterior level of choanae, the ridges separated mesially by distance half length of one ridge; pair of elongate bony mandibular processes in lower jaw directed upwards and backwards fitting into two deep pockets in front of palate; no vocal sac; tongue large, its posterior horns moderate.

Arms and legs short; finger tips swollen a little but not or scarcely wider than digit; three metacarpal tubercles median largest, flat, rather indistinct; subarticular tubercles distinct; two middle fingers



FIG. 46.—*Rana kuhlii* Schlegel, in Duméril and Bibron. No. 36556 ♂. Actual snout-vent length, 95 mm. Doi Pna Kao, near Doi Inthanon, Chiang Mai, Thailand.

with lateral skin-ridges or fringes present for a greater or lesser distance; first finger equal to length of second, or a little less; leg short, thick, tibiotarsal articulation reaching eye; toes widened into small but distinct discs lacking a peripheral groove; toes fully webbed; a fine skin-fold along outer edge of outer toe; a well-defined tarsal fold; inner metatarsal tubercle elongate, compressed.

Skin above slightly corrugated on head and anterior part of back; sides with small glandular warts; limbs above, especially on back part of tibia and tarsus, with strong, pearl-tipped spines; chin, venter, front and most of undersurface of thighs smooth; a pair of short, poorly defined dorsolateral lines, moderately distinct anteriorly in young, indistinct in adult specimens.

*Color in life:* Olive-brown above on dorsum; a black, light-edged interorbital bar; back with some rounded or irregular darker spots usually with small lighter centers; arms and legs barred with brown; a light mark from eye back to jaw angle; upper lip and jaw darker, with some blackish marks; lower jaw clouded or spotted with brown. Chin and venter yellowish, as is much of the underside of thigh; brownish on sole and palm.

*Measurements in mm.* (Nos. 33933 ♂, and 34905 ♀ [Phu Kading, Loei]): Snout to vent, 93, 80; width of head, 47, 32; length of head, 44, 29; arm, 48, 42; leg, from vent, 116, 107; tibia, 39, 35; foot and tarsus, 53, 48.

*Variation:* The obvious variation in the species is sexual. The heads of the males are greatly widened and often the occipital region shows two well-marked swellings. The heads of the females are narrower without any obvious swelling. They lack the bony processes in the front of the lower jaws. Neither sex has a vocal sac or slits. In both males and females a well-defined fold may be present across the head at the posterior level of the orbits. In many specimens this is not in evidence. A few specimens, both males and females, have a median cream-yellow stripe, usually somewhat wider on head than elsewhere. While most specimens show no external trace of a tympanum, in several the inferior part of the tympanum can be discerned. Very young specimens, and occasionally older specimens show two rows of rounded dark spots on the back, each spot with a tiny light-colored tubercle in its center. The black and light bars in the interorbital region are always present, the light bar wider and preceding the other. Specimens from Southern Thailand and Malaya are especially rugose on the upper surface of the femur and tibia.



FIG. 47.—*Rana kuhlii* Schlegel, in Duméril and Bibron. No. 34014 ♀. Actual snout-vent length, 57 mm.; Doi Suthep, 3000 ft. elev., Chiang Mai, Thailand.



*Distribution:* In Thailand, specimens have been taken or reported from the provinces of Chiang Mai, Phrae, Loei, Narathiwat, Nakhon Si Thammarat and Yala. It has been taken in Malaya in the states of Perak, Selangor, and Negri Sembilan. It also occurs in Southern China and Formosa.

*Remarks:* This is an aquatic frog that is almost never seen outside of water. Usually the frogs are partly submerged among rocks or debris in rivulets or streams in mountains up to 1400 meters and perhaps higher. When disturbed the animal takes refuge under a submerged stone, hides in soft mud, or enters holes of fresh-water crabs which are usually available. While younger specimens seem plentiful, fully adult specimens are more rarely taken.

*Rana hascheana* (Stoliczka)

FIG. 48

*Polypedates hascheanus* Stoliczka, Journ. Asiat. Soc. Bengal, vol. 39, 1870, p. 147, pl. 9, fig. 3 (type locality).

*Rana gracilis* var. *andamanensis* (part.) Stoliczka, *ibid.*, 1870, p. 142.

*Rana hascheana* Sclater, Proc. Zool. Soc. London, 1892, p. 344; Flower, Proc. Zool. Soc. London, 1899, pp. 894-895; Laidlaw, Proc. Zool. Soc. London, 1900, p. 885; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 197; Boulenger, A vertebrate fauna of the Malay Peninsula from the Isthmus of Kra to Singapore . . . Reptilia and Batrachia, 1912, pp. 232-233; Rec. Ind. Mus., vol. 20, 1920, pp. 54-55. M. Smith, Rec. Ind. Mus., vol. 31, 1929, p. 77; Bull. Raffles Mus., no. 3, 1930, pp. 100-101.

*Rana limborgii* Sclater, Proc. Zool. Soc. London, 1892, p. 344, pl. 24 (type locality, Tenasserim); Boulenger, Rec. Ind. Mus., vol. 20, 1920, pp. 56-57; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 2, Dec. 1916, p. 165 (Maprit and Klong Bang Lai, Prachuap Khiri Kahn); M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 3, May, 1917, p. 228 (peninsular and northern Siam).

*Diagnosis:* A small frog, maximum length of females about 38 mm. snout to vent; of males about 35. No vocal slits or vocal sac evident in males; series of dim elongate dorsolateral tubercles that sometimes suggests a broken dorsolateral fold; tongue small, bifid, free posteriorly for one fourth of its length; sides of throat wrinkled longitudinally in males; tibiotarsal articulation to front of eye; diameter of tympanum (2.9 mm.) smaller than eye length (3.6 mm.); first finger shorter than second or equal in length; toes one-third or less webbed, tips scarcely dilated; eggs large, few, unpigmented, three millimeters in diameter.

*Description of species* (from No. 36110, Doi Suthep, about 3000 ft. elevation): Head rather pointed oval; canthus rostralis distinct, rounded; eye small, its length little greater than its distance from nostril; latter only slightly closer to tip of snout than to eye; inter-orbital space considerably greater than width of eyelid in males,

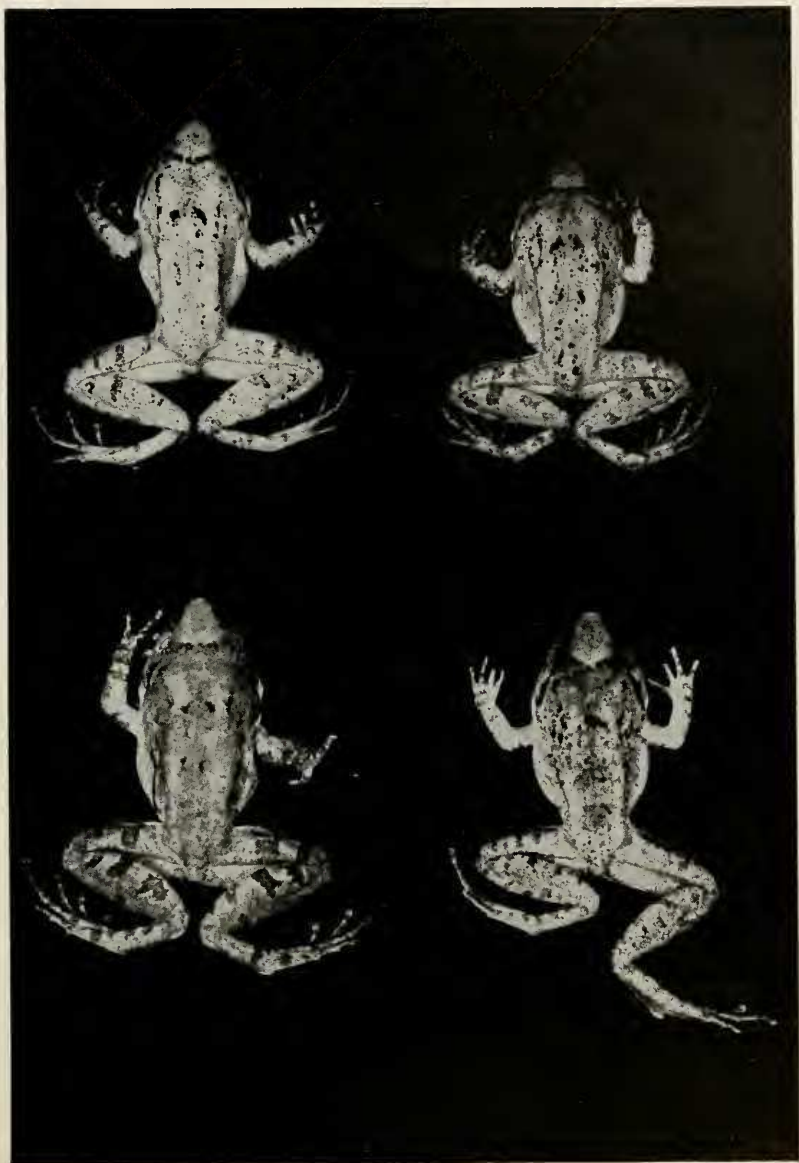


FIG. 48.—*Rana hascheana* (Stoliczka). Upper left, No. 35968. Actual snout-vent length, 33 mm. Upper right, No. 35969, length, 31 mm. Lower left, No. 35920, length, 34.5 mm. Lower right, No. 36106, length, 33 mm. All from Doi Suthep, elevation *circa* 3000-3500 feet, Chiang Mai, Thailand. (All males.)

less in females; occipital region slightly swollen; well-defined curved supratympanic fold from eye to near arm-insertion passing along edge of tympanum; loreal region oblique, then rounding under upper jaw; snout projecting one and one-half millimeters beyond mouth; tympanum somewhat smaller than eye.

Vomerine teeth in two oblique ridges extending back from line within hinder edge of choanae, separated from its fellow by distance nearly equal to length of one ridge; openings of palatal glands very close to front edge of palate; space between front of choanae and palate small, strongly vertical; tongue rather small, bifid, free behind for one fourth of its length; apparently no vocal sacs or slits, however, skin under jaws longitudinally wrinkled. Arm short, fingers reaching beyond tip of snout; first and second fingers equal or first slightly less; digits not or scarcely widened at tip; leg with tibio-tarsal joint reaching slightly in front of eye; slight tarsal fold; prominent strong inner metatarsal tubercle; no outer; subarticular tubercles weak; tips of toes with small discs; toes less than one-third webbed.

Skin on top of head, occipital region, and sides of head smooth; back with a dorsolateral row of elongate tubercular ridges suggesting a broken dorsolateral fold; pair of tubercles just back of occiput, and other tubercles scattered on back; sides with smooth flat granules; small fold on breast limiting throat folds; venter with transverse wrinkles; front and underside of thighs smooth, except mesially where there is a large patch of flat granules lateral to and behind vent. A few scattered black-topped tubercles on tibia.

*Color in life:* Body usually yellowish or yellowish brown; an area on snout lighter than occiput; an indistinct band between eyes; side of snout blackish, with three spots more or less separated by yellow-cream areas; area in front of tympanum light, with dark spot above tympanum; lower jaw indefinitely marked with darker spots; venter and chin yellow; under thighs and concealed parts of limbs yellowish or cream; a faint dark mark (often W-shaped) on shoulders with other dark brown or blackish flecks on dorsum; thigh and tibia barred with brown, spots not continuous when leg is folded; sole of foot and tarsus purplish.

*Variation:* The four specimens figured suggest the variation in markings that obtains in this species. I have followed Malcolm Smith in regarding *Rana limborgii* Selater a synonym.

*Distribution:* In Thailand the species is known from Chiang Mai, and Chumphon provinces. It is probably much more widely spread

Measurements in mm. of *Rana hascheana*

Number.....	36110	36109	36107
Sex.....	♂	♂	♂
Snout to vent.....	34	34	32
Snout to arm-insertion.....	18	18	14
Axilla to groin.....	13	13	11.5
Width of head.....	16.8	16	13.5
Length of head.....	14.8	14	13.8
Arm.....	19	20	18.2
Leg.....	54.3	56	50
Tibia.....	19	19.3	16.2
Foot and tarsus.....	24	24	22

but the solitary habits and the fact that it occurs at high elevation makes it rather difficult to obtain.

The species occurs in India, Burma, Malaya, and Viet Nam.

*Remarks:* In 1958 I found this frog plentiful on Doi Suthep, Chiang Mai during the month of June. Males were calling through the forest, their cry sounding very much like a crow-call, *caw-caw*, the syllable repeated twice. The animal is actually on the ground under leaves, but the sound they make seems to come from everywhere. It was indeed first mistaken for the call of a crow, and thought to be in the forest trees.

The frogs are very shy and the least noise seems to cause them to stop their calling for some time. When a specimen is finally located in some limited area one has to move the leaves carefully, for when uncovered the frog usually escapes with long rapid leaps. The males usually are found to be calling from shallow pits, often with rims above the surrounding surface, which they have dug out and rounded. In several cases a second cup was in the immediate vicinity in which were found freshly laid eggs, older eggs with tadpoles, or young transformed frogs of very small size sitting on the edge of the cup.

This species of *Rana* has what amounts to direct transformation, since the tadpole stage is undergone in the egg, and there is no free swimming stage.

A set of relatively freshly-laid eggs were left on May 28 with Mrs. Birgit Degerbøl Hansen at the Forest Experimental Station on Doi Suthep near Chiang Mai, who kindly agreed to watch their behavior since I was scheduled to leave Thailand. The mud cup in which the eggs were laid was transferred to a glass container. At this time the eggs consisted of round masses of unpigmented

yellow yolk in large round clear masses of jell, each more than a centimeter in diameter. Concerning the lot Mrs. Hansen \* has made the following notes:

"June 2. There are small thin yellow larvae to be seen riding on top of the yolk like thin threads, which can move a little when touched. One fixed in formalin and later transferred to alcohol.

"June 4. Larvae still small compared to the mass of yolk which is now covered with visible blood vessels. Small knotlike processes present that show beginning of limbs behind the head, and at the site of future legs.

"June 7. Noticable growth of larvae. The tail is elongated and can be beaten vigorously. The hind leg protuberances are now distinct. One fixed at this stage.

"June 12. Legs are growing but as yet are not leg-shaped.

"Between June 12 and June 20 we were away from headquarters. On our return the tadpoles were quite dry (still in the earth cup in the glass jar) except for the 'egg slime'. As soon as a little water was added they began moving their elongate tails rather rapidly. They now have both the front and hind legs, that is, they now have the shape and appearance of true legs; there is still the long tail and much of the yellow yolk is present. They move usually only when disturbed and all remain still in the cup.

"June 21. Limbs growing fast, the tail now diminishing. The unpigmented yolk, partly surrounded, now looks like a big yellow stomach.

"June 25. Now three of them have only a small curved tail which is not used for body movements. They can now hop about. One fixed.

"June 28. Tail now almost gone. One fixed (it is less than one centimeter long). One was found dead. This was preserved.

"July 8. The last two frogs were found dead. These were preserved."

Another species, *Rana opisthodon* Boulenger belonging to the subgenus *Discodeles*, is reported as dispensing with the ordinary type of life history, the young emerging from the eggs, which are laid in moist crevices of rocks close to the water, in perfect condition with limbs and without a vestige of a tail. The eggs measure 6 to 10 millimeters in diameter.

The species *Rana hascheana* Stoliczka has always been regarded as belonging to *Rana*, *sensu strictu*. If this association is correct

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\* I wish to express my keen appreciation to Mrs. Hansen for having made these important observations on this erratic *Rana* species.



this mode of life history has probably been developed quite independently.

*Rana erythraea* (Schlegel)

FIGS. 49, 50

*Hyla erythraea* Schlegel, *Abbildungen neuer oder unvollständig bekannter Amphibien* . . . 1837, p. 27, pl. 9, fig. 3 (type locality, Java).

*Limnodytes erythraeus* Duméril and Bibron, *Erpétologie Générale* . . . vol. 8, 1841, p. 511, pl. 88, fig. 1; Cantor, *Journ. Asiat. Soc. Bengal*, vol. 16, 1847, p. 1062.

*Hylarana erythraea* Tschudi, *Mem. Soc. Sci. Nat. Neuchâtel*, vol. 2, 1839, pp. 37, 78; Günther, *The reptiles of British India*, 1864, p. 425; Boulenger, *Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum*, 1882, pp. 65-66, fig. a; *The fauna of British India, Ceylon, and Burma; Reptilia and Batrachia*, 1890, pp. 460-461; Flower, *Proc. Zool. Soc. London*, 1896, p. 902, pl. 45, fig. 2; *ibid.*, 1899, p. 895; Laidlaw, *Proc. Zool. Soc. London*, 1900, p. 885; Butler, *Journ. Bombay Nat. Hist. Soc.*, vol. 15, 1903, p. 198; Van Kampen, *Nat. Tijdschr. Ned.-Indie*, vol. 69, 1909, p. 35; Boulenger, *A vertebrate fauna of the Malay Peninsula* . . . *Reptilia and Batrachia*, 1912, pp. 241-242; M. Smith, *Journ. Nat. Hist. Soc. Siam*, vol. 1, no. 4, Dec. 1915, p. 249; (Klong Yai and Ok Yam, Trad province); *ibid.*, vol. 2 no. 2, Dec. 1916, p. 167 (Nakhon Si Thammarat and Narathiwat provinces); *ibid.*, vol. 2, May, 1917 (Bangkok); *ibid.*, vol. 2, no. 4, Dec. 1917, p. 267; Boulenger, *Rec. Ind. Mus.*, vol. 20, 1920, p. 152; M. Smith, *Bull. Raffles Mus.*, no. 3, 1930, p. 108; Taylor and Elbel, *Univ. Kansas Sci. Bull.*, vol. 38, pt. 2, 1958, p. 1064, fig. 8 (Loei province).

*Diagnosis:* Rather large frogs (78 mm.) usually green with broad dorsolateral fold covered with yellow stripe; broad dark stripe on sides of head and body; snout pointed and projecting; fingers slender, first little shorter than second; toes nearly entirely webbed; small discs on digit tips; tibiotarsal articulation to tip of snout; no cross-bars on limbs but often marks paralleling leg present; vocal sac absent; well-defined nuptial pad on first finger of male.

*Description of species* (from No. 34715, Bhetong, Yala): Body elongate, slender; head longer than wide, snout nearly on level with back; canthus rostralis obtuse, loreal region slightly concave, oblique; eyelid width about equal to interorbital width; length of eye only slightly less than length of snout; tympanum distinct, its diameter equal to five eighths of length of eye, separated from eye by distance equal to about half its diameter.

Choanae rather small, posteriorly placed in palate, visible from below; vomerine teeth in two nearly transverse ridges lying between choanae, separated from them by slightly shorter distance than that between the two ridges; openings of palatal glands in broken groove between front of palate and vomerine teeth but closer to latter; tongue elongate, notched rather deeply behind (male without vocal sacs).



FIG. 49.—*Rana erythraea* (Schlegel). No. 35680. Actual snout-vent length, 67 mm. Ronpibon, Tonka Harbour Tin Mine, Nakhon Si Thammarat, Thailand. (Variety.)

Arm and legs moderately slender. Digits tips widened into small elongate discs each with peripheral groove; first finger not extending beyond second; subarticular tubercles rather large; three metacarpal tubercles, median smallest, three or four supernumerary tubercles on palm; fingers with lateral ridges or skinfolds; legs with tibiotarsal articulation reaching nostril; when legs are folded at right angles to body, heels overlap several millimeters; toes four-fifths webbed, webs reaching discs only as narrow fringe on inner side of digits; small inner metatarsal tubercle, a small rounded outer; no tarsal fold.

Skin above minutely corrugated (seen under a lens); sides with few flattened warts; strongly defined, rather wide, dorsolateral glandular fold from eye to end of rump, distinctly above tympanum,



FIG. 50.—*Rana erythraea* (Schlegel). Upper figure, No. 33424. Actual snout-vent length, 62 mm., Bangkok, Thailand. Lower, No. 35818, length, 64 mm., Khao Chong, Trang, Thailand.

which has no tympanic fold; a second broken glandular fold begins behind tympanum and extends short distance on side; separate gland below and behind tympanum; chin, venter, and part of underside of thighs smooth; part of ventral and most of posterior surface of thigh granular.

*Color in life:* Above bright green on head and back, the color less intense posteriorly; yellowish stripe from eye covers dorso-lateral fold, bordered on each side by blackish line; dark greenish line from tip of snout follows loreal region and side of body to near rump, widening on side. Tympanum brown with somewhat lighter center; upper and lower jaw cream; lateral stripe cream-white; all lower parts pure white; legs grayish or greenish gray with indistinct longitudinal markings indicated; undersurface of foot light lavender.

*Measurements in mm.:* Snout to vent, 75; width of head, 22.5; length of head, 25.8; arm, 45; leg from vent, 121; tibia, 40; foot and tarsus, 57.

*Variation:* Young specimens usually fail to show the brilliant green coloring of the adults. Males are much smaller than females, usually under 55 millimeters in length, and the tympanum is slightly larger proportionally. There is some difference discernible in the width of the dorsolateral gland and stripe, and in the length and distinctness of the lateral glandular fold. Males have a flat gland on inner lower surface of arm, while the chin, breast, and part of venter has glandular skin, the minute glandules appearing as flecks of yellowish white below the surface of the transparent skin.

*Distribution:* The species is widely distributed in Thailand, in the lowlands. I have taken it in the following provinces, always in the immediate vicinity of water: Chiang Mai, Nong Khai, Loei, Ubon, Phatthalung, Nakhon Si Thammarat, Trang, and Yala.

It has been reported from Trad and Narathiwat; also Bangkok.

It is known also in Burma, Malaya, and in the Indo-Australian Archipelago; Negros and Panay in the Philippine Islands.

*Remarks:* Adults are usually to be found in water, the top of the head showing. Occasionally I have found specimens in shrubs beside pools. At one such place the frogs seemed to be reluctant to leave the shrub and hopped about in the branches rather than jump into the water.

The species is probably related to *Rana macrodactyla*.

*Rana macrodactyla* (Günther)

FIG. 51

*Hylorana macrodactyla* Günther, Catalogue of the Batrachia Salientia, 1858 (1859), p. 72, pl. 2, fig. C (type locality, Hong Kong [restricted]); The reptiles of British India, 1864, p. 424.

*Rana trivittata* Hallowell, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 504 (type locality \_\_\_\_\_).

*Hylorana subcaerulea* Cope, Proc. Acad. Nat. Sci. Philadelphia, 1868, p. 140. (type locality, Rangoon, Burma).

*Rana macrodactyla* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata, in the British Museum, 1882, p. 54; The fauna of British India, Ceylon, and Burma; Reptilia and Batrachia, 1890, p. 455; Flower, Proc. Zool. Soc. London, 1899, p. 895; Laidlaw, Proc. Zool. Soc. London, 1900, p. 885; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, pt. 2, Oct., 1903, p. 198; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 238-239; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 2, Dec., 1916, p. 167 ("Bangnara, Patani" [= Narathiwat, Narathiwat]); *ibid.*, vol. 2, no. 3, May, 1917, p. 228 (widely distributed not uncommon, found in Bangkok); *ibid.*, vol. 2, no. 4, Dec., 1917, pp. 265-266, pl. figs. 3, 3a, 3b; Boulenger, Rec. Ind. Mus., vol. 20, 1920, p. 155; M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 108; Cochran, Proc. U. S. Nat. Mus. vol. 77, 1930, p. 5 (Bangsoon, near Chumphon); *ibid.*, Metcalf, vol. 87, 1940, p. 540 (Trang).

**Diagnosis:** A very slender frog, the digits elongate, first finger not longer than second; pair of narrow white or cream stripes following narrow dorsolateral glandular fold; tympanum distinct, nearly as large as eye; toes and foot elongate, half webbed; two metatarsal tubercles; no vocal sacs; a glandular lateral fold.

**Description of species** (from No. 34925, Ubon): Body slender, foot large elongate; head slender pointed; nostril much closer to tip of snout than to eye; canthus rostralis rounded, loreal region oblique somewhat concave behind nostril; tympanum large, its greatest diameter (4.5 mm.) less than length of eye (5 mm.); tip of snout extending beyond mouth; width of eyelid less than inter-orbital width.

Choanae rather large, situated posteriorly, close to orbits, visible when seen from below; vomerine teeth on oblique ridges beginning near inner anterior edge, and lying almost completely between and anterior to posterior level of choanae; palatal glands opening in a straight groove equidistant between front of palate and anterior level of vomerine tooth ridges; tongue elongate, well-notched behind; vocal sac absent.

Arm slender, fingers long, first distinctly shorter than second; three metacarpal tubercles, median largest; subarticular tubercles well developed; tips of fingers swollen into small discs lacking peripheral groove; legs long and slender; tibiotarsal articulation reaches beyond tip of snout; when legs are folded at right angles



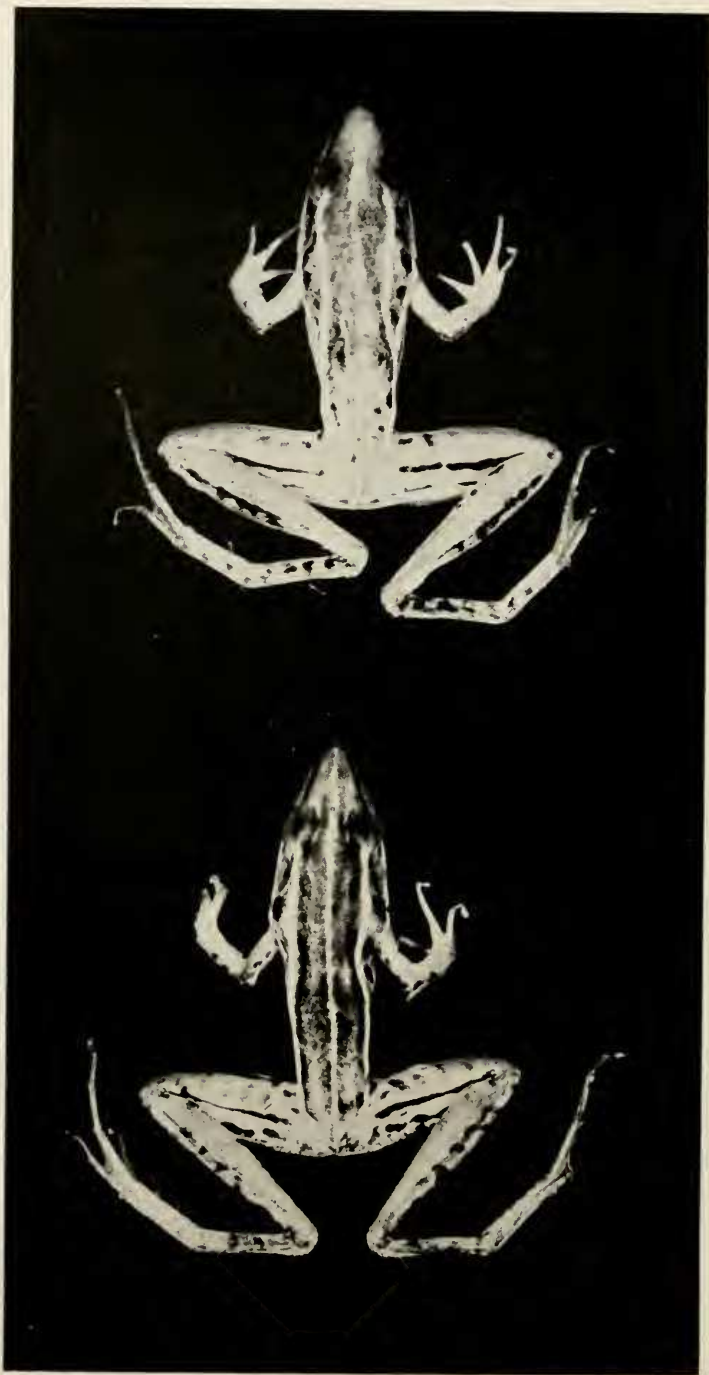


FIG. 51.—*Rana macrodactyla* (Günther). Upper, No. 34926 ♀. Actual snout-vent length, 39 mm. Lower, No. 34925 ♀. Actual snout-vent length, 39 mm. Ubon, Ubon, Thailand.

heels overlap five millimeters; toes with small discs bearing peripheral grooves; toes about one-half webbed, web reaching to near discs as fine fringe on some of inner fingers; outer metatarsal separated by web; small inner metatarsal tubercle and smaller outer; no tarsal fold; subarticular tubercles well developed.

Skin smooth on head, dorsum, and upper part of limbs; chin and venter smooth; sides with few flat warts; median ventral and posterior face of thigh with regular granulation or areolation; dorso-lateral glandular fold, and a broken lateral fold beginning behind tympanum extends along sides to near groin.

*Color:* Above olive to bronzy-brown with narrow median light-cream line, and dorsolateral cream lines from eye to groin covering dorsolateral glandular folds; on sides numerous small brownish spots, the lateral fold below them white; arms and legs light brownish with transverse cream line on thighs bordered above and below with a transverse brown line; below this line brown spots often coalescing; tibia brown with spots of darker brown on anterior face; tympanum light-brown with lighter center; dark band from tip of snout to eye crossing loreal region.

*Measurements in mm.* (Nos. 34925-34926, Ubon): Snout to vent, 39, 39.5; width of head, 11, 11.3; length of head, 16.2, 16; arm, 22, 22; leg, 76, 75.5; tibia, 23, 24; foot and tarus, 33, 36.3.

*Variation:* Most of the differences that obtain are color variations. However, most of the specimens conform to the described pattern.

*Distribution:* The species which is usually a lowland form, has been taken in Chiang Mai, Loei, Nong Khai, Ubon, Chon Buri, Chumphon, Phatthalung, Narathiwat, and Trang provinces.

Specimens were taken by me in Loei Province on the summit of Phu Kading at about 5000 ft. elevation. Elsewhere, I have found them only in lowlands.

*Remarks:* The species is most commonly found in rice fields and swampy places. It is especially active and capable of making long leaps, thus difficult to catch. M. Smith (Dec., 1917) states: "I know of some half dozen spots [around Bangkok] from where I can obtain as many specimens as I wish, but the rest of the country, although not differing apparently in any way, seems to be entirely devoid of them."

I propose to restrict the type locality to Hong Kong.

*Rana cubitalis* M. Smith

FIG. 52

*Rana cubitalis* M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1917, p. 277 (type locality, "Doi Nga Chang, Thailand, 1600 ft. elev."); Boulenger, Rec. Ind. Mus., vol. 20, June 1920, pp. 138; 139 (redescription of type?); M. Smith, Rec. Ind. Mus., vol. 26, 1925, p. 138 (tadpole); \* Bull. Raffles Mus., no. 3, 1930, pp. 94, 103-104, fig. 5 (Nakhon Si Thammarat; Karen Hills, Burma); Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, Mar. 20, 1958, pp. 1058-1060, fig. 5 (Na Haeo, Dan Sai, Loei province, Thailand).

*Rana (Hylarana) cubitalis* Bourret, Les Batraciens de l'Indochine, 1942, pp. 316-317, fig. 92.

*Diagnosis:* Moderately slender, elongate frogs, reaching a length of approximately 75 mm. in females; narrow dorsolateral glandular fold; toes about four-fifths webbed, webs not reaching discs on inner sides of second, third, and fourth toes; digits with small but distinctly widened discs; tibiotarsal articulation reaches two to five millimeters beyond tip of snout; strongly defined brown diagonal spot covers tympanum; dark line borders canthus; vomerine teeth on two ridges diagonally placed between large choanae. Male with large nuptial gland on inner face of forearm; a flat conspicuous gland in front of arm-insertion.

*Description of species* (from No. 31748, Na Haeo, Dan Sai district, Loei province): Snout obtusely pointed, slightly longer than eye; sharp canthus rostralis; loreal region nearly vertical above jaw, distinctly concave; nostril much nearer tip of snout than to eye; jaw below eye and tympanum with distinct elevation or ridge; width of upper eyelid equals interorbital width; tympanum distinct its diameter (6.2 mm.) distinctly less than eye length (8 mm.), its distance from eye about equal to its diameter.

Choanae rather large, vomerine teeth on two oblique ridges between choanae, but extending behind their posterior level, separated from each other by distance equal to their distance from choanae; tongue large, with two prominent posterior horns, free for little more than half its length; (males with vocal sac, the openings small, in floor of mouth behind level of tongue).

Skin finely granular with few small scattered tubercles above posteriorly; sides similar, but with an irregular row of larger granules; distinct narrow dorsolateral fold beginning behind eye runs to near level of vent; chin and venter smooth; skin of upper arm coarsely granular; underside of thighs coarsely and regularly granular; posterior face of thigh with larger and smaller granules intermixed; front face of thighs smooth.

\* Malcolm Smith states that Boulenger's redescription (Records Indian Museum, vol. 20, 1920, pp. 138-139), is not of the type (Smith No. 2836, B. M. No. 1919.3.28.5), but of another specimen.



FIG. 52.—*Rana cubitalis* M. Smith. EHT-HMS No. 31748 ♀. Ban Na Muang, Na Haeo (village), Dan Sai (district), Loei (province), Thailand. Actual snout-vent length, 76 mm.

Arms and legs long, slender; digit tips expanded into small but distinct discs, each disc with peripheral groove; hand with three metacarpal tubercles, inner largest; first finger distinctly longer than second; subarticular tubercles distinct; toes about four-fifths webbed, web not reaching discs on inner side of second to fourth toes; outer metatarsal separated by web; tibiotarsal articulation reaches a centimeter beyond tip of snout; compressed inner metatarsal tubercle and well-defined low conical outer tubercle; subarticular tubercles prominent; when legs are folded at right angles to body heels overlap strongly.

*Color:* Above light fawn, nearly uniform on head and on body between dorsolateral folds; strongly defined dark diagonal mark behind eye including tympanum (but tympanum medium brown rather than black); dark line from eye to eye around front of snout below canthus rostralis; a few brown flecks on jaws and diagonal dark mark below arm-insertion (where, in the male, there is a well-defined gland); some dark marks on underside of arm; legs with light-brown bars, the bars continuous when legs are folded; dark mark about vent; four blackish spots under tibia and several along front of thighs; undersurface of tarsus and foot dark purplish lavender.

Measurements of *Rana cubitalis*

Number.....	31748	31747	32062
Sex.....	♀	♀	♀
Snout to vent.....	73	74	62
Width of head.....	24.4	23.2	21
Length of head.....	26	26	23.1
Arm.....	41.5	41	36
Leg (from vent).....	126	137	103
Tibia.....	44	43.2	36
Foot and tarsus.....	54.2	62	44

*Variation:* In younger specimens the black marks on the body are more sharply defined. The upper eyelids are rugose posteriorly and the tympanum is proportionally a little larger.

The males have internal vocal vesicles. There is a nuptial pad on the first finger extending as a broad band along the inner side of the forearm and expanding into a large rounded gland on inner side of elbow. An oval flat gland is present on each side of the breast in front of the base of arm.

The color of the type is described as being light olive (grayish



in alcohol) above and on sides with an irregular chain of small black spots along each flank. The limbs have dark crossbars, and the posterior surface of thighs are marbled with dark brown, the venter being whitish. A dark streak is present along the canthus rostralis, and there are dark spots on the lips. The tympanum is dark brown.

*Distribution:* Besides the type locality, the species is known from Na Haeo, Dan Sai district, Loei province, which is the source of the three measured specimens. It has been taken also in the Karen Hills of Burma, and in the mountains of Nakhon Si Thammarat.

*Remarks:* The species is said to be most closely related to *Rana guentheri* Boulenger. In profile it resembles strongly an Indian species *Rana leptoglossa* Cope.

### *Rana miopus* Boulenger

FIG. 53

*Rana humeralis* \* M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 2, Dec. 1916, pp. 148, 167 (not of Boulenger); *ibid.*, vol. 2, no. 3, May, 1917, p. 229 (Nakhon Si Thammarat).

*Rana miopus* Boulenger, Journ. Nat. Hist. Soc., Siam, vol. 3, no. 1, Nov., 1918, pp. 11-12 (type locality, Khao Wang Hip, Nakhon Si Thammarat); Rec. Ind. Mus., vol. 20, 1920, pp. 148-149; M. Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 273 (Pahang, Malaya); Bull. Raffles Mus., no. 3, 1930, pp. 105-106 (Kuala Tembeling and Kuala Tahan, Pahang; Chikus Forest Reservoir, Perak).

*Rana lateralis* (non Boulenger) Laidlaw, Proc. Zool. Soc., London, 1900, p. 886, pl. 67, figs. 1, 2 (Kuala Aring, Ulu Kelantan); Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Amphibia, 1912, pp. 239-240 (*part.*); Butler, Proc. Zool. Soc., London, 1902, p. 189; Boulenger, Fasciculi Malayenses, Zoology, 1903, p. 172 ("Biserat, Jalor, Siam"); Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 201; Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 24.

*Rana (Hylarana) miopus* \*\* Bourret, Les Batraciens de l'Indochine, 1942, pp. 326-327, fig. 92 ("Biserat, Jalor, Siam").

*Diagnosis:* Body slender, the head slightly wider than body; strong dorsolateral folds; tympanum distinct, as large as eye in male; strong humeral glands; external vocal sac; first finger longer than second; no lateral band on side of head; elongate, somewhat widened discs on digits; toes at least three-fifths webbed; fine diagonal glandular ridges (left to right) on back.

*Description of species* (from EHT-HMS No. 136 Kuala Tahan, King George V National Park, Pahang): Length of head little greater than width; snout with distinct, somewhat rounded canthus rostralis extending forward beyond nostrils; tip rather pointed,

\* The record of *Rana humeralis* Boulenger published by M. Smith must be eliminated from the Thai fauna. The specimen on which the record was based has been made the type of *Rana miopus*.

\*\* The specimen figured fails to show the distinct diagonal lines of *miopus*, mentioned in the text.



FIG. 53.—*Rana miopus* Boulenger. EHT-HMS No. 136. Actual snout-vent length, 71 mm. Kuala Tahan, King George Nat. Park, Pahang, Malaya.

then sloping back and downwards to mouth; snout reaching two millimeters beyond mouth; loreal region sloping obliquely, concave; width of an eyelid a little greater than interorbital width; tympanum large, its diameter (7.2 mm.) slightly less than length of eye (7.8 mm.); two external vocal sacs behind and below mouth-angles, indicated externally by numerous short folds.

Vomerine teeth in two diagonal ridges arising from anterior inner edge of small choanae, directed obliquely backward behind level of choanae and separated by a distance little less than length of one ridge; palatal glands open into mouth through four small openings in middle of palate, about equidistant from level of choanae and front of palate; tongue large, strongly forked behind, free for two fifths of its length; vocal slits small, puckered, back near angle of mouth.

Arms strong, first finger distinctly longer than second with noticeable nuptial pad on upper surface of first finger, and another above strong inner metacarpal tubercle; latter larger than median or outer metacarpal tubercles; subarticular tubercles distinct; no supernumerary tubercles; terminal discs scarcely developed, legs moderately long, tibiotarsal articulation reaches a little in front of eye; when legs are folded at right angles to body heels overlap five millimeters; toes with terminal discs somewhat widened and elongated, rather pointed, with peripheral grooves on sides of discs; subarticular tubercles strong, somewhat elongated; strong inner metatarsal tubercle and small outer; sole with a few small granules; inner toes about three-fifths webbed, a little more on third and fifth toes; fourth toe elongate, slightly less than length of tibia.

Skin above with very numerous fine pearl-tipped pustules, nearly smooth on snout; pair of well-developed dorsolateral folds from eyes to groin; several fine diagonal ridges running across back; sides smooth except in area posterior to tympanum; venter and part of underside of thigh smooth, with indication of small breast fold; posterior part of underside of thigh and much of posterior surface with minute regular granules; on dorsal surface granules pustular, and a little longer.

*Color:* Above gray-olive on head and body with some indefinite darker streaks following diagonal ridges; sides dirty yellowish-white, but olive behind tympanic area; arms lighter, dimly barred; legs dimly barred; on back of thigh, a fine dark reticulation on a yellowish ground color; sole and underside of tarsus and toes dark lavender. Entire under surface yellowish white.

Measurements in mm. of *Rana miopus*

Number.....	136	135	Type
Sex.....	♂	♀	♀
Snout to vent.....	71	67	73
Head length.....	26	25.6	25
Head width.....	25	23	25
Arm.....	44.2	41	46
Leg.....	115	104	108
Tibia.....	38	34	35
Foot and tarsus.....	53	47.2	.....
Fourth toe.....	36	32.3	.....

*Variation:* Boulenger gives the color of the type as: "grayish above with pink patches on the back, sides, and limbs and with large blackish blotches on the limbs with indistinct cross-bands; hinder side of thighs black, speckled and vermiculated with white."

The second specimen (No. 135) also a female, differs in coloration in having the loreal and tympanic areas dark-olive with a black line from eye above tympanum which widens into a diagonal black blotch behind tympanum. A black mark in the position of the humeral gland of male, and some small black spots in the groin. The limbs are rather distinctly barred. There is a black area about the vent and very dark discrete spots on back of tibia. The thighs are black posteriorly. On the back there are some diagonal markings; the tibiotarsal articulation reaches about halfway between the eye and nostril. The vomerine teeth-ridges are very slightly diagonal.

*Distribution:* The species is known only from the type locality in Nakhon Si Thammarat, Thailand. In Malaya, specimens have been taken in the states of Pahang and Perak.

*Remarks:* The presence of diagonal ridges on the bodies of these frogs is unusual since it represents a marked asymmetry.

*Rana nicobariensis nicobariensis* (Stoliczka)

FIG. 54

*Hylorana nicobariensis* Stoliczka, Journ. Asiat. Soc. Bengal, vol. 39, 1870, p. 150, pl. 9, fig. 2 (type locality, Nicobar Islands).

*Rana nicobariensis* Boulenger, Ann. Mag. Nat. Hist., ser. 5, vol. 16, 1885, p. 389; The fauna of British India, Ceylon, and Burma; Reptilia and Batrachia, 1890, p. 459; Ann. Mag. Nat. Hist., ser. 6, vol. 8, 1891, p. 291; Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 20; Boulenger, Journ. Federated Malay States Mus., vol. 3, 1908, p. 62; A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia (*part.*), 1912, pp. 240-241; M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 108 (Nakhon Si Thammarat); Boulenger, Rec. Ind. Mus., vol. 20, 1920, pp. 162-165.

*Rana javanica* Annandale, Journ. Federated Malay States Mus., vol. 7, 1917, pp. 108, 109 (Jalor Caves, Biserat, peninsular Siam).

*Rana erythraea* var. *elongata* Werner, Jahresb, Nat. Ver. Magdeburg, 1892, p. 253 (type locality, Nias).

*Rana lemniscata* Boettger, Zool. Anz., 1893, p. 337.

*Rana nicobariensis nicobariensis* Inger, Fieldiana Zool., vol. 33, 1954, pp. 331-334 (part.)

**Diagnosis:** A small slender frog (55 mm.); very fine dorsolateral glandular fold; dorsal skin very finely granular (sometimes nearly smooth in gravid females); canthus rostralis distinct; width of inter-orbital space greater than width of upper eyelid. Tympanum distinct; small but distinct discs on digits; first finger longer than second; inner and outer metatarsal tubercle present; heel to tip of snout; dark stripe on side of head and body; uniform white, or brown spotted on venter.

**Description of species** (from M. Smith No. 6163 [F 44], Nakhon Si Thammarat): Head longer than broad, snout more or less pointed, equal or longer than diameter of orbit; canthus rostralis distinct, side of head nearly vertical, loreal region somewhat concave; tympanum distinct, its diameter (3 mm.) two thirds to three fourths that of eye, separated from eye by distance equal to about one third diameter of tympanum; nostril nearer tip of snout than to eye.

Choanae rather large, elongate, with vomerine teeth on two diagonal ridges beginning near upper level of choanae but not reaching beyond their posterior level, separated from each other by a distance equal to length of one ridge; tongue elongate, slender, free for about one fourth of its length; (male with vocal sac and flat oval gland on inner side of arm); skin shagreened above on head and dorsum; sides with coarser granules; fine dorsolateral glandular fold from eye to above groin; sides of shoulders, chin, venter, and underside of limbs smooth; limbs slender, all digits widened at tips into distinct discs with a groove around periphery; fingers slender unwebbed, first finger longer than second; all fingers with slight lateral ridges extending to discs; two metacarpal tubercles; toes at least two-thirds webbed, web continuing as very narrow fringe to discs; compressed elevated inner metatarsal tubercle, small rounded outer; no tarsal fold; tibiotarsal articulation reaches between eye and nostril; when legs are folded at right angles to body heels overlap about five millimeters.

**Color:** Above grayish to reddish brown, nearly uniform on head; back with indistinct darker and lighter markings; dark-brown stripe from snout along side of head covering tympanum and reaching some distance on side; labial region yellowish, with fine dusting of





FIG. 54.—*Rana nicobariensis nicobariensis* (Stoliczka). M. S. No. 6163 ♀. Actual snout-vent length, 41 mm. Nakhon Si Thammarat, Thailand.

pigment; three yellow glands behind lower level of tympanum; sides, chin, venter, and underside of limbs with indistinct darker marks formed of fine pigment flecks; arms and legs barred; underside of foot dark.

*Measurements in mm.*: Snout to vent, 41; width of head, 11; length of head, 15; arm, 25; leg, 67; tibia, 22.5; foot and tarsus, 34.

*Distribution*: In Thailand the species has been found in the province of Nakhon Si Thammarat, the described specimen being from this locality. Outside of Thailand the species is known in the Nicobar Islands, Malaya, and the larger and some small islands of the Indo-Australian Archipelago. It is replaced in the Philippines by two related forms: *suluensis* and *sanchezi*. A subspecies occurs in Java. Its presence on small islands suggests that it may have considerable tolerance to salt-water.

### *Rana chalconota* (Schlegel)

FIG. 55

*Hyla chalconota* Schlegel, Abbildungen neuer oder unvollständig bekannter Amphibien, 1837, p. 24, pl. 9, fig. 1 (type locality, Java).

*Lymanodytes chalconotus* Duméril and Bibron, Erpétologie Générale . . . vol. i, 1841, p. 513.

*Hylarana chalconota* Günther, Catalogue of the Batrachia Salientia . . . 1858 (1859), p. 73.

*Rana chalconota* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata . . . 1882, p. 66; Rec. Ind. Mus., vol. 20, 1920, p. 201; M. Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 274 (Kuala Teku, Malaya); van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, p. 217; M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 109 (unites *chalconota* and *labialis*), (Khao Ram, Nakhon Si. Thammarat); Tasan and Mamoh, Chumphon province.

*Rana labialis* Boulenger, Ann. Mag. Nat. Hist., ser. 5, vol. 19, 1887, p. 345, pl. 10, fig. 1 (type locality, Malacca); Ann. Mus. Civ. Genova, ser. 4, vol. 14, 1894, p. 617; Flower, Proc. Zool. Soc. London, 1896, p. 903, pl. 45, fig. 3; Peracca, Rev. Suisse Zool., vol. 7, 1899, p. 329; Laidlaw, Proc. Zool. Soc. London, 1900, p. 886; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 199; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 242-243; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1916, p. 168 (Nakhon Si Thammarat); *ibid.*, vol. 2, no. 3, May 1917, p. 229; van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, p. 220; Cochran, Proc. U. S. Nat. Mus., vol. 77, 1930, p. 5 (Khao Luang, Nakhon Si Thammarat).

*Diagnosis*: Head longer than broad; body slender with fine distinct even granulation on dorsum; posterior part of venter and underside of thigh with somewhat larger regular granules; toes with widened discs, nearly entirely webbed; discs of fingers larger; dorso-lateral glandular fold distinct anteriorly; outer metatarsals separated by web; tibiotarsal articulation to beyond tip of snout; snout longer than eye.



FIG. 55.—*Rana chalconota* (Schlegel). Upper figure, No. 34721 ♀. Actual snout-vent length, 40 mm. Lower figure, No. 34436, length, 44 mm., 15 km. NE Bhetong, Yala.

*Description of species* (from No. 392 Khao Chong, Trang): Head slender, flattened, body slender, snout pointed, elongate; loreal region nearly vertical, strongly concave; canthus strong, obtuse; nostrils much nearer to tip of snout than to eye; diameter of tympanum four fifths length of eye, which is shorter than snout. Vomerine teeth in two short oblique ridges beginning some distance from inner edge of choanae but extending behind their posterior level, separated mesially by a distance about equal to length of one ridge; choanae large; no vocal sac.

Arm moderate, outer fingers elongate, with strong terminal discs half as large as tympanum; inner fingers short, first less than second. (A pronounced swelling at outer base of first finger in male; another farther forward on first finger, probably nuptial swellings.) Toes four-fifths webbed; discs smaller than on fingers; small inner and smaller outer metatarsal tubercle; no tarsal fold, subarticular tubercles well developed, stronger on hand than on foot; supernumerary tubercles on hand; tibiotarsal articulation reaches half centimeter beyond tip of snout. When legs are folded at right angles to body, heels overlap strongly.

Skin of head and back covered thickly with very small regular granules, those on sides somewhat larger; distinct dorsolateral glandular fold, stronger anteriorly, continuous with straight supratympanic fold; several glandules below and behind tympanum; posterior part of upper jaw somewhat thickened; chin and breast smooth; back part of venter with aerolate granules, greater part of ventral and posterior face of thigh with similar granules; upper surface of limbs nearly smooth; elongate glandular area low on sides.

*Color in life:* Above olive to olive-brown, darker on top of head; lighter on arms than on legs; narrow blackish mark from tip of snout bordering canthus; chin, venter, and underside of limbs with spots of finely powdered pigment; palms lightly pigmented; soles and web heavily pigmented; back of thigh light-brown with lighter flecking; banding on limbs not discernible; a fine olive reticulation on back of thigh enclosing yellowish flecks.

*Measurements in mm.* of No. 392 ♀ and 34725 ♂, respectively: Snout to vent, 43.5, 31; axilla to groin, 20, 13.5; snout to eye, 7, 5.6; diameter of tympanum, 4, 3.75; eye length, 6, 4; width of head, 13.8, 10; length of head, 17, 12; arm, 25.5, 21; leg, 71, 56.5; tibia, 25, 19; foot and tarsus, 31.5, 25.

*Variation:* In the series at hand, the color in life varied from

occasional green to greenish olive to bronze-brown above, the sides dull brownish, the tympanum light-brown. The spotting on venter was often very dim, sometimes stronger. The dorsolateral glandular fold is often dim and rarely extends as far as rump.

The largest specimens measure about 55 millimeters snout to vent.

*Distribution:* In Thailand records for *chalconota* (and *labialis*) are confined to the peninsular part of the country. The species occurs in the following provinces: Prachuap Khiri Khan, Nakhon Si Thammarat, Trang, Phatthalung, Songkhla, and Yala.

Outside of Thailand, the species occurs in Malaya and the Indo-Australian Archipelago.

*Remarks:* Specimens are usually found during the day sitting along banks of small forest rivulets or streams while at night they are often seen perched on leaves of low plants or in shrubs in wet places.

The vocal sac, in the males, opens through small puckered openings back at the level of the mouth-angle.

Boulenger (1920) says: "I now regard *R. labialis* from the Malay peninsula, as a variety of the typical *R. chalconota* from Java, from which it differs in the usually shorter foot as compared with the tibia, the rather more slender hind limbs, and the smaller sizes; but intermediate specimens completely connect the two extreme forms."

*Rana chalconota* may easily be confused with the males, especially young males of *Rana hosii*. The resemblance is great.

### *Rana glandulosa* Boulenger

FIG. 56

*Rana glandulosa* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum, 2nd Ed., 1882, p. 73, pl. 7 (type locality, Sarawak); Ann. Mag. Nat. Hist., ser. 6, vol. 8, 1891, p. 291; *ibid.*, ser. 6, vol. 14, 1894, p. 87; Flower, Proc. Zool. Soc. London, 1896, p. 905; Butler, Journ. Federated Malay States Mus., vol. 3, 1905, p. 63 (Kuala Lipis, Malaya, 200 ft. elev.); Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 236-237; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 2, Dec. 1916, p. 167 ("Bangnara, Patani" (= Narathiwat, Narathiwat)); *ibid.*, vol. 2, no. 3, May, 1917, p. 228; Annandale, Mem. Asiat. Soc. Bengal, vol. 6, 1917, p. 146; Boulenger, Rec. Ind. Mus., vol. 20, 1920, pp. 181-182; M. Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 272 (Fraser's Hill, Malaya); Bull. Raffles Mus., no. 3, 1930, p. 102 (Langsuan, Chumphon).

*Diagnosis:* Rather large frogs (65 mm.); eyes very large, inter-orbital distance less than width of upper eyelid; first finger extending beyond second; toes about two-thirds webbed; two metatarsal



tubercles; tibiotarsal articulation to eyes or tip of snout. Back and sides covered with large flat glandules; paired vocal sacs; large oval gland on inner side of arm.

*Description of species* (from No. 1522, Bhetong, Yala): Head rather flat, smooth, without tubercles or glandules except on back of occiput; snout rounded; canthus rostralis distinctly obtuse, loreal region wider than interorbital distance (4.6 mm.); length of eye (8 mm.) equal to snout length (8.05 mm.); tympanum distinct, its greatest diameter (4.6 mm.) less than length of eye; separated from eye by a distance (3 mm.) less than its diameter.

Choanae small visible when palate is viewed from below; vomerine teeth on two short elevated ridges near inner edge of choanae extending somewhat behind level of choanae, separated by a distance equal to length of one ridge; tongue large, bifid posteriorly, free for little more than one third of its length; openings of paired vocal sacs into mouth small, rounded, somewhat puckered; glands of palate open into a short groove slightly in advance of anterior level of choanae.

Arm well developed, when brought forward wrist and part of forearm reaches beyond snout; digits slender, tips dilated into very small discs, only two outer with a peripheral groove; no transverse groove on under surface of disc; subarticular tubercles well developed; four distinct supernumerary tubercles and three larger well-defined metacarpal tubercles, inner largest. A strongly defined gland on front face of upper arm; fingers without trace of web or trace of lateral ridges; first finger distinctly longer than second, slightly larger than fourth, and reaching to base of disc on fourth.

Legs long, tibiotarsal articulation reaching tip of snout or slightly beyond; when legs are folded at right angles to body, heels overlap seven millimeters; first and second toes with only a web remnant, second and third, one third webbed, three outer toes a little less than half webbed; discs a little larger than those on fingers, all with a peripheral groove; two well-developed metatarsal tubercles, outer only little smaller than inner; no tarsal fold; subarticular tubercles large; outer metatarsal separated by web for much of its length; web forming small ridges extending to near discs on most toes.

Skin of head smooth; shoulders, back, sides, upper surfaces of femora, tibiae, and tarsus with very numerous large flat pitted pustules or granules, largest and almost continuous on shoulders and above arm-insertion. Chin, breast, arms, outerpart of under-



FIG. 56.—*Rana glandulosa* Boulenger. No. 1522 ♂. Actual snout-vent length, 62 mm. Bhetong, Yala, Thailand.

side of femur and its anterior face, underside of tibia, and tarsus glassy smooth; skin of venter transversely wrinkled, posterior and undersurface of femur with flat pavementlike irregular granules.

*Color in life:* Above lavender-gray, with rather indistinct flecking and spotting with dark gray or black. Arms and legs somewhat brownish with dark bands; sides with some whitish flecks; lips with three dark spots separated by brownish-cream vertical marks; chin purplish lavender with some lighter flecks; venter and much of underside of limbs grayish with marbling or reticulation of dark lavender; a lighter median area under femora; posterior face of femora blackish lavender spotted with cream. Eye red.

Measurements in mm. of *Rana glandulosa*

Number.....	1522	34713	34712
Sex.....	♂	♀	♀
Snout to vent.....	62	55	55
Width of head.....	24.8	20	21
Length of head.....	25	22.1	22
Arm.....	41	36	38
Leg.....	101.4	87	90
Tibia.....	32	30	29.4
Foot and tarsus.....	49	41	39

*Variation:* In most frogs the females are larger than males. It is possible that the female of this species does not reach as large a size as the male since the largest male in the British Museum series is 92 mm., the largest female, 83 mm. Some specimens are reddish brown above in life, while the ventral surface may be whitish or buff, uniform or spotted.

*Distribution:* In Thailand I have taken specimens in Trang and Yala provinces. It has been reported from "Bangnara, Patani" [= Narathiwat, Narathiwat], and Langsuan, Chumphon province by Malcolm Smith. Elsewhere it is known in Malaya and Borneo.

*Remarks:* Boulenger (1912) states that: "This is one of the creatures found in the Batu Caves, Selangor, Malaya in total darkness."

The call of this species is very loud, perhaps louder than the calls of other ranas taken in Thailand. I have observed the frog in the act of calling and the vocal sac seemingly is not large. During the day the specimens have been taken from under old stumps or logs.

The specimens I have studied from Thailand have the dorsal and

lateral glandular areas much more pronounced than in Boulenger's figure (1882) and the femora and tibia are distinctly barred with black. The legs, too, would appear longer, the tibiotarsal articulation reaching the tip of snout or beyond.

*Rana nigrovittata* (Blyth)

FIG. 57

*Limnodytes nigrovittatus* Blyth, Journ. Asiat. Soc. Bengal, vol. 24, 1855, p. 718 (type locality, Mergui, Tenasserim, Burma).

*Rana nigrovittata* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, p. 334, pl. 8, fig. 3; Flower, Proc. Zool. Soc. London, 1899, p. 896; Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 20; Boulenger, A vertebrate fauna of the Malay Peninsula . . . . Reptilia and Batrachia, 1912, p. 242; Smith and Kloss, Journ. Nat. Hist. Soc. Siam, vol. 1, no. 4, Dec., 1915, p. 249. (Two specimens reported from Koh Chang; both unusually large, one measuring 72 mm. snout to vent.); M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 1; June, 1916, pp. 37, 42, 43, pl., upper fig.; *ibid.*, pt. 2, Dec. 1916, p. 168 (Klong Bang Lai, Prachuap Khiri Khan); M. Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 274; Bull. Raffles Mus., no. 3, 1930, pp. 94, 107 (mountains of Nakhon Si Thammarat); Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, Mar. 20, 1958, pp. 1060-1063, figs. 6, 7.

*Diagnosis:* A medium-sized frog (average full-grown adult about 60 mm. occasionally reaching 75 mm. *vide infra*.) Tips of fingers swollen into small discs, two outer at least with a peripheral groove; toes with distinct discs, all with a peripheral groove; toes four-fifths webbed; two metatarsal tubercles; supernumerary tubercles and three large palmar tubercles on hand; first finger longer than second; dorsolateral fold thick, distinct; males with gland on outer front base of arm.

*Description of species* (from No. 12740 ♂, Nakhon Nayok): Snout oval, projecting but little beyond mouth; canthus rostralis somewhat rounded, loreal region slightly oblique, somewhat concave behind nostril; length of eye shorter than length of snout; tympanum large, distinct, its diameter about five eighths of length of eye; separated from eye by distance equal to half its diameter; interorbital width slightly less than width of upper eyelid; occipital region slightly swollen; vomerine teeth in two small elevated groups between choanae, each group about size of choanae, widely separated from choanae and each other, extending somewhat behind hind level of choanae; tongue moderately notched, free behind for little more than one fourth of its length; palatal glands opening into transverse groove between vomerine teeth and front of palate; internal vocal sac, opening (in this specimen) on left side only, back behind level of mouth angle.



FIG. 57.—*Rana nigrovittata* (Blyth). No. 1274 ♂. Actual snout-vent length, 59 mm. Nakhon Nayok, Thailand.



Fingers moderate, first longer than second, tips swollen into small discs, two outer at least, with peripheral groove; three large subequal palmar tubercles and five supernumerary tubercles on outer palm; subarticular tubercles well developed; scarcely a trace of lateral ridges on fingers.

Toes with small well-developed terminal discs, each disc with peripheral groove; toes four-fifths webbed, web failing to reach discs on inner side of second and third toes; well-developed, slightly compressed, inner metatarsal tubercle and small rounded outer; no tarsal fold; subarticular tubercles well developed; no supernumerary tubercles; when legs are folded at right angles to body, heels overlap two millimeters; tibiotarsal articulation reaches slightly beyond tip of snout.

Skin on head nearly smooth; on body fine tubercular granules, intermixed with a few larger tubercles; lateral tubercles large, flat; thick dorsolateral glandular fold passes back from eye to above thigh, not touching tympanum; two glands below and behind tympanum; gland on front base of upper arm (males only). Chin, venter, and underside of limbs smooth; middle and posterior part of undersurface of thigh with fine granules that extend up along side of vent; legs and to a lesser extent arms, with fine tubercular granules.

*Color in life:* Above olive-brown; head with some darker marbling; some indistinct darker flecks on back; black stripe from snout to eye; tympanum dark, area behind it black, extending to groin as narrow black line on outer edge of dorsolateral glandular fold; sides greenish and grayish white; chin and breast gray-white; underside of thighs with slight yellowish wash; back of thighs yellow-olive with reticulum of black; both limbs more or less banded with olive; webs blackish.

*Measurements in mm.* (Nos. 1274 ♂, 31772 ♂, 1005 ♀, respectively): Snout to vent, 59, 70, 59; width of head, 24, 31, 22; length of head, 22, 27, 21; arm, 34, 42, 36; leg, 93, 113, 95; tibia, 30.5, 38, 32; foot and tarsus, 42, 51, 42.

*Variation:* Specimens for the most part follow the scheme of markings here recorded, except that the larger proportion of both males and females have chin, venter, and underside of limbs dark. The outer metatarsal is separated by a web almost to the tarsus.

The expected size of fully grown specimens is about 60 millimeters but occasionally considerably larger specimens appear. M. Smith (Dec., 1915) reports a specimen measuring (snout to vent)

72 millimeters in length; and Taylor and Elbel figure a specimen measuring 70 mm.

*Distribution:* In Thailand this species is known from the following provinces: Chiang Mai (Doi Suthep); Loei (Phu Kading, 1045 m. elev.); Sakhon Nakhon, (Knok Phu, and Phu Phan, 500 m. elev.); Ubon, (Sanoi River); Nakhon Sayok (mountain near); Chon Buri, near Siracha; Chumphon, (Tasan, near Isthmus of Kra); Nakhon Si Thammarat (mountains).

Outside of Thailand the species occurs in Tenasserim, Burma, Viet Nam, and northern Malaya.

*Remarks:* This species has been taken along the edge of the lake near Siracha, Chon Buri. A few specimens were found in a small pool at a spring a few yards away from the Sanoi River in Ubon, and others were heard calling during the dry season from rather inaccessible crevices among river boulders. One was captured among rocks in a small stream near the Forest Station in Nakhon Nayok.

In the described specimen the vocal sac had only a single, rather than a double opening into the mouth. This condition is certainly an anomaly.

### *Rana lateralis* Boulenger

FIG. 58

*Rana lateralis* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 5, 1887, p. 483, pl. 8, fig. 2 (type locality, Kokarit, east of Moulmein, Tenasserim); The fauna of British India . . . Reptilia and Batrachia, 1890, p. 457; Boulenger, The fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 239-240 (on basis of Laidlaw's report of a specimen from Kelantan, This specimen actually is *R. miopus* fide. M. Smith); Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 3, May, 1917, p. 228; Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 4, Dec., 1917, pp. 266-267, pl.-fig. 1, 1a, 1b, tadpole; Boulenger, Rec. Ind. Mus., vol. 20, 1920, p. 96-98.

*Diagnosis:* A distinct, moderately thick dorsolateral fold; tympanum large, equal to or slightly less than area of eye; upper jaw thickened with white stripe, becoming slightly elevated posteriorly; strong posttympanic tubercle behind mouth-angle; heel to front of eye; eyelid width greater than interorbital width; well-developed gland on arm of males; a pair of well-separated oblique vomerine teeth-ridges between choanae; male with vocal sac and small posterior vocal slits; digits slightly swollen at tips; toes three-fifths webbed; first finger much longer than second.

*Description of species* (from No. 33817, Doi Suthep, Chiang Mai): Head narrow, longer than wide; snout acuminate much longer than eye, extending beyond lower jaws for two millimeters; loreal region



FIG. 58.—*Rana lateralis* Boulenger. Upper figure, No. 36176 ♂. Actual snout-vent length, 49 mm. Lower figure, No. 36031 ♀. Length, 59 mm. Both from Kaeng Pang Tao. Chiang Mai, Thailand.

oblique, concave. Nostril a little closer to tip of snout than to eye; canthus rostralis sharply defined; diameter of tympanum (5 mm.) slightly less than length of eye-opening, scarcely separated from eye; strongly defined dorsolateral fold beginning behind eye; slight posttympanic fold extends from dorsolateral fold diagonally down behind tympanum crossing its upper posterior border; lower jaw surface thickened posteriorly surface being somewhat elevated behind jaw; behind this a separate tubercle.

Vomerine teeth on two short transverse ridges rising from posterior inner edge of choanae, separated mesially by distance nearly equal to length of one ridge; palatal glands open into short transverse groove, closer to anterior level of choanae than to front of palate; tongue strongly notched behind, free posteriorly for half its length; choanae completely visible when seen directly from below.

Arm with moderately distinct fold or glandular ridge on underside of forearm, first finger longer than second, with indistinct metacarpal tubercles; subarticular tubercles strong; tips of digits slightly swollen at tips but scarcely wider than digits; toes half to two-thirds webbed; very strong, compressed, shovellike inner metatarsal tubercle, and small outer; rather indistinct tarsal fold or glandular thickening on tarsus; tibiotarsal articulation to eye; when legs are folded at right angles to body heels touch but do not overlap. Skin, seen under a lens, finely and evenly roughened by minute corrugations; posteriorly on dorsum, lateral area below dorsolateral line, and upper surface of thigh, with some very small tubercles; tibia with some fine elongated ridges; chin and venter, smooth, or slightly wrinkled; posterior- and undersurface of thigh covered for most part with equal-sized granules.

*Color:* Above greenish or olive in life becoming light-brown in fixative; sides somewhat darker with dark stripe below canthus rostralis; black diagonal stripe behind posttympanic fold; side darker than dorsum with blackish-edged dark brown spots low on side and in groin; dark stripe or row of black marks on front edge of thigh and tibia; tympanum dark brown; light stripe on upper jaw.

Chin and breast with suggestion of a median light mark; remainder of underside strongly clouded with darker; venter and side of limbs yellowish; hands below light; undersurface of foot and tarsus blackish; dim bands on limbs; black spot near point of arm-insertion where in male a gland occurs; back of thigh dark brown with a few dim light marks.

*Measurements in mm.:* Snout to vent, 55; length of snout, 9; length of eye, 6; width of head, 22; length of head, 20; arm, 28.5; leg, 75; tibia, 24.5; foot and tarsus, 35.

*Variation:* No. 33821 is a male with two well-defined black glands on front of arm near insertion; the first finger has two rather well-defined nuptial asperities, one at base the other reaching forward to level of the subarticular tubercle. The thighs are dark brown with white dots or vermiculations; a pair of rounded slits open into the vocal sacs, the slits very far back near corners of mouth.

A female specimen figured shows a black line following the dorsolateral glandular fold for some distance.

*Distribution:* The species is to be found in northern Thailand, most of my specimens having been taken in Chiang Mai province. A specimen was taken in Kanchanaburi Province near the city of that name. None has been reported from Peninsular Thailand, and it is unknown in Malaya. M. Smith (1917) reports it in central, southeastern and eastern Thailand.

*Remarks:* I found the species breeding in a recently flooded rice paddy area at Kaeng Pang Tao, Northern Chiang Mai province, June 16, 1958.

*Rana aenea* M. Smith

FIG. 59

*Rana aenea* M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 4, no. 4, July 25, 1922, pp. 210-212, pl. 8, fig. 1 (type locality, Doi Chang, N. Siam, elev. 1500 meters altitude).

*Diagnosis:* A small species, 38 mm. snout to vent; no bony prominences in lower jaw; canthus distinct; interorbital width less than width of eyelid; tympanum indistinct; first finger as long as second; tibiotarsal articulation reaching beyond snout; toes about two-thirds webbed; no tarsal fold, one metatarsal tubercle only; skin smooth; fine dorsolateral glandular fold beginning behind eyelid, converging towards its fellow on shoulder.

*Description of species* (from type description): Head broader than long; snout rounded, slightly projecting beyond mouth, as long as orbit; canthus rostralis distinct, loreal region oblique, slightly concave; nostril equidistant from eye to tip of snout; distance between nostrils twice interorbital width, which is less than that of upper eyelid. Tympanum indistinct, less than half diameter of eye, one and one-half times its distance from latter.

Vomerine teeth in small, slightly oblique series, commencing



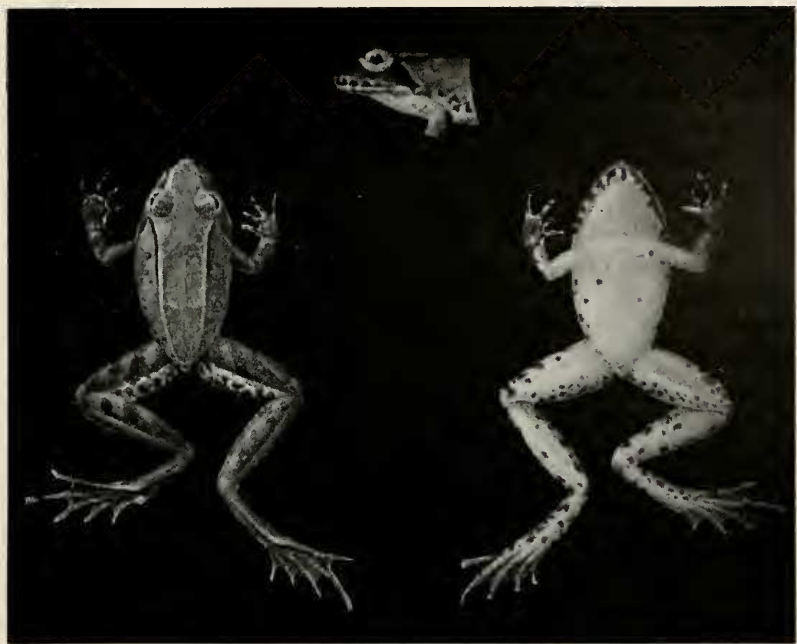


FIG. 59.—*Rana aenea* M. Smith. M. S. No. 5821 ♀. Actual snout-vent length, 35 mm. Doi Chang, Chiang Mai, Thailand, elev. 1500 m.

from level of posterior borders of choanae, equidistant from them and from each other; no bony prominences on lower jaws in males.

Fingers moderate, tips slightly swollen, first as long as second, third shorter than snout; subarticular tubercles moderate. Leg long, tibiotarsal articulation reaching well beyond snout; heels strongly overlapping when limbs are folded at right angles to body; toes moderate, tips dilated into small but very distinct discs, two-thirds webbed, nearly three phalanges of fourth toe free; no groove on discs separating upper from lower surfaces; no tarsal fold; subarticular tubercles moderate, inner metatarsal tubercle moderate, three-fifths length of inner toe; no outer tubercle.

Skin quite smooth; posterior half of upper eyelid warty; a glandular fold from eye to shoulder; a fine glandular dorsolateral fold beginning behind upper eyelid, converging towards its fellow on shoulders and extending to hip.

*Color:* Brownish or grayish-black above, sides with small rounded, jet-black spots; dorsolateral fold indicated by a thin whitish line edged outside with black on forepart of body; supratemporal fold with similar markings; black band including tympanum; lips black

with white spots, limbs with black crossbars. Below yellowish white, throat finely speckled with black; belly and limbs with larger black spots.

*Measurements in mm.* (type and paratype, respectively): Snout to vent, 35, 38; length of head, 12.5, 14; width of head, 14.5, 15.5; snout length 6, 6.5; eye, 5, 5; interorbital width, 2.5, 3; tympanum, 2, 2; arm, 20, 22; leg, 65, 74; tibia, 22, 25; foot, 20, 22.

*Variation:* A second female (No. 5822) collected in the same locality differs in having the vomerine teeth slightly more prominent, the tympanum more distinct, and the dorsolateral fold present only halfway down the back.

*Distribution:* The species is known only from the type locality, Doi Chang, N. Siam.

*Remarks:* M. Smith regards *Rana aenea* as being nearest to *R. palawanensis* Boulenger from the Malay Archipelago. It differs from it in the smaller and less distinct tympanum, in the smaller digital discs and shorter first finger, in the convergence of the dorsolateral folds and in coloration (compared with two specimens from N. Borneo). Characters of the male are not known.

### *Rana signata* (Günther)

FIG. 60

*Polypedates signatus* Günther, Proc. Zool. Soc. London, 1872, p. 600; pl. 40, fig. C (type locality, Borneo).

*Rana signata* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum, 1882, p. 71; Werner, Zool. Jahrb., Syst. Band 13, 1900, p. 493; Laidlaw, Proc. Zool. Soc. London, 1900, p. 886; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 237-238; Boulenger, Rec. Ind. Mus., vol. 20, 1920, pp. 177-179; van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, p. 227 (*picturata* = *signata*); M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 103 (Tasan, Isthmus of Kra).

*Rana obsoleta* Mocquard, Nouv. Arch. Mus., ser. 3, vol. 2, 1890, p. 147.

*Rana picturata* Boulenger, Rec. Ind. Mus., vol. 20, 1920, p. 179; M. Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 272 (Pahang).

*Rana signata* Inger, Fieldiana. Zoology, vol. 33, 1954, p. 312 (*part.*).

*Diagnosis:* Medium small frogs, digits with small discs; outer metatarsals separated by web; dorsolateral fold; toes two-thirds webbed; two metatarsal tubercles; skin smooth or finely granular above; male with internal vocal sac; length of eye greater than length of snout; dark olive, brownish or black above; white or yellowish line from snout-tip on side of head and continued dorsolaterally on body. Numerous whitish or reddish spots on back; limbs barred with whitish, cream, or red.



FIG. 60.—*Rana signata* (Günther), EHT-HMS, No. M.153a, Kuala Lumpur, Selangor, Malaya. Actual snout-vent length, 35 mm.

*Description of species* (from EHT-HMS, M153a, Kuala Lumpur): Head rather narrow, snout rounded or slightly truncate anteriorly, nostrils nearer snout than eye; interorbital width greater than width of upper eyelid; canthus rostralis distinct, loreal region strongly concave; length of eye equal or slightly greater than length of snout; tympanum distinct, its diameter about half length of eye, separated from eye by a distance less than half its diameter.

Choanae large, vomerine teeth in two oblique groups wholly between choanae, but not reaching their posterior level, separated from each other by distance nearly equal to length of one group; an internal vocal sac present.

Arm moderate, first finger distinctly longer than second; small nuptial swelling at base of first finger (in male); tibiotarsal articulation reaches somewhat beyond tip of snout; small inner metatarsal tubercle and small outer; no tarsal fold; subarticular tubercles strong on fingers, somewhat smaller on toes; digits with tips widened into discs; toes from between one-half to two-thirds webbed.

Skin smooth over most of body; a few tubercles on thigh below vent.

*Color:* Above violet or lavender brown (probably dark olive in life) with yellow-cream line across tip of snout passing along sides of head, continued on dorsolateral region to groin (partly broken into spots); sides, back, head, and limbs with numerous cream spots; entire lower surface of body and limbs heavily powdered with black giving skin a dirty brownish-gray cast.

*Measurements in mm.:* Snout to vent, 35; axilla to groin, 16; head width, 12; head length, 13; arm, 27; leg, 64; tibia, 20.5; foot and tarsus, 28.

*Variation:* The tibiotarsal articulation may reach only to nostril; occasionally the upper surface of body is completely but finely granular. The species may reach a length of 60 millimeters. Another specimen taken by me near Kuala Lumpur had red spots and a red dorsolateral stripe.

*Distribution:* In Thailand the species has been taken only at Tasan, Isthmus of Kra in the province of Chumphon. It is probably rare, otherwise its conspicuous coloration would have permitted it to be seen and taken more frequently. Elsewhere the species occurs in Malaya and the Indo-Australian Archipelago.

*Rana luctuosa* (Peters)

FIG. 61

*Limnodytes luctuosa* Peters, Monatsb. Akad. Wiss. Berlin, 1875, p. 579 (type locality, Borneo); Ann. Mus. Civ. Genova, vol. 3, 1872, p. 43, pl. 6, fig. 1.

*Rana luctuosa* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 1882, p. 68; Ann. Mag. Nat. Hist., ser. 6, vol. 7, 1891, p. 341; Flower, Proc. Zool. Soc. London, 1896, p. 904, pl. 46; *ibid.*, 1899, p. 896; Hanitsch, Journ. Straits Asiat. Soc., vol. 34, 1900, p. 73; Boulenger, Fasciculi Malayenses, Zoology, 1903, p. 172; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 199; Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 24; van Kampen, Amphibien des Indischen Archipel . . . Leiden, 1906, p. 411; Barbour, Mem. Mus. Comp. Zool. Harvard College, vol. 44, 1912, p. 169; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 238; M. Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 273 (Fraser's Hill, Malaya); van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, p. 196; M. Smith, Bull. Raffles Mus., no. 3, 1930, pp. 94, 103; *ibid.*, 1931, p. 16.

*Rana (Limnodytes) luctuosa* Mocquard, Nouv. Arch. Mus. Paris, ser. 3, vol. 2, 1890, p. 122.

*Rana decorata* Mocquard, Le Natur., 1890, p. 155; Nouv. Arch. Mus., ser. 3, vol. 2, 1890, p. 145, pl. 10, fig. 1, 1a, 1b; Boulenger, Ann. Mag. Nat. Hist., ser. 6, 1891, p. 341.

*Rana (Hylorana) luctuosa* Boulenger, Rec. Ind. Mus., vol. 20, 1920, pp. 183-184.

**Diagnosis:** Medium-sized frogs, snout to vent length ♀ 60, ♂ 45 mm.; snout bluntly rounded; canthus obtuse; snout projecting somewhat beyond mouth; first finger longer than second; second and third fingers with lateral dermal ridges; toes with web only at base; tips of digits widened into small discs, each with a peripheral groove; heel to or little beyond tip of snout; narrow dorsolateral white or yellow line borders red or red-brown color of back; male lacking vocal sac and slits.

**Description of species** (from No. 6527, Khao Ram, Nakhon Si Thammarat): Snout broadly rounded anteriorly; distance between lateral nostrils one and a half times interorbital width, which in turn is wider than an upper eyelid; snout rather flattened at tip extending beyond mouth; canthus broadly rounded, loreal region slightly concave, nearly vertical; tympanum large, its greatest diameter equal to four fifths of length of eye; eye length shorter than snout; distance between tympanum and eye less than half diameter of tympanum.

Vomerine teeth on two small elevations between choanae, widely separated from choanae and from each other, neither group as large as a choana; latter concealed when viewed directly from below; small group of openings of palatal glands in middle of palate not far from anterior level of choanae; tongue free for a third of its length and free on sides; male lacking vocal sac and





FIG. 61.—*Rana luctuosa* (Peters). M. S. No. 6527. Actual snout-vent length, 46 mm.; Khao Ram, Thailand.

slits; skin of head and dorsum shining smooth; skin of side generally smooth with minute pits (seen under a lens); chin, venter, and underside of limbs smooth; about half of posterior surface of thigh granular, especially area around vent.

Arms smooth, fingers moderately long, first longer than second; three metacarpal tubercles, that at base of first finger largest; sides of fingers with fine folds of skin extending from discs to base of middle digits.

Toes less than one-third webbed, but webs bordering sides of digits as small free flaps to discs; flat inconspicuous inner metatarsal tubercle, smaller rounded outer tubercle; tips of all digits widened into small discs, each with a peripheral groove; subarticular tubercles moderately developed.

*Color:* Above reddish brown to magenta, bordered dorsolaterally with whitish line that crosses edge of eyelid and surrounds the tip of snout; sides of head and body brownish to brownish black, with

few whitish flecks; tympanum light-brown with darker center; whitish elongate gland below tympanum; limbs brown indistinctly marked with transverse darker bars separated by whitish dots or lines; back of thigh and underside of tibia dark-brown with numerous whitish flecks; throat dark; venter dirty brownish buff with some lighter flecks.

*Measurements in mm.* (M. S. Nos. 6614, and 6527): Snout to vent, 42, 46; width of head, 15.1, 15; length of head, 16.2, 18; arm, 25, 24; leg, 74, 73; tibia, 23, 24; foot and tarsus, 33, 33.

*Variation:* The toes may be one-third webbed, but it is usually less. Boulenger's description (1912) states that the outer metatarsal tubercle is absent, and the tibiotarsal articulation may not reach the tip of the snout; the vomerine teeth in No. 6614 are better developed than in the one described, and the choanae are not hidden when seen from below.

*Distribution:* The species in Thailand seems to be confined to the southern part of the peninsula coming as far north as the province of Nakhon Si Thammarat. It is known outside Thailand in Malaya where it is common on Penang Island at elevations of 2000-2200 feet; and in the Larut Hills Park at an altitude of 4000 ft. It is also known in Borneo where it was first taken. The described specimen is from Nakhon Si Thammarat.

### *Rana alticola* Boulenger

FIG. 62

*Hylorana tytleri* (non Theobald) Stoliczka, Journ. Asiat. Soc. Bengal, vol. 39, 1870, p. 148, pl. 9.

*Rana tytleri* (non Theobald), (*part.*) Boulenger, The fauna of British India, Ceylon, and Burma; Reptilia and Batrachia, 1890, p. 458.

*Hylorana pipiens* Jerdon, Proc. Asiat. Soc. Bengal, 1870, p. 83.

*Rana alticola* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum, 1882, pp. 62-63, fig. (type locality, Khasi Hills; Sikkim; Moulmein); Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, p. 334; Annandale, Rec. Ind. Mus., vol. 8, 1912, pp. 8, 22, pl. 4, fig. 1; vol. 26, 1924, p. 138, fig.; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, pt. 2, Dec. 1916, p. 167; *ibid.*, vol. 2, pt. 3, May, 1917, p. 228 (Patiyu = Prachuap Khiri Khan); Annandale, Mem. Asiat. Soc. Bengal, vol. 6, 1917, p. 140, 144; Boulenger, Rec. Ind. Mus., vol. 20, 1920, pp. 166-169; M. Smith, Rec. Ind. Mus., vol. 26, 1924, p. 138, fig. tadpole; M. Smith, Bull. Raffles Mus., no. 3, 1930, pp. 106-107.

*Rana nigrovittata* Scater, Proc. Zool. Soc. London, 1892, p. 345 (*part.*).

*Rana leptoglossa* (not of Cope), Annandale, Mem. Asiat. Soc. Bengal, vol. 6, 1917, 140, fig.

*Diagnosis:* Medium-small frog (52 mm.); a narrow dorsolateral fold present; tibiotarsal articulation to tip of snout or beyond; limbs very slender; males with internal vocal sacs; no gland on arm; first

finger longer than second; large very prominent subarticular tubercles; outer metatarsals separated by a web almost to tarsus; two metatarsal tubercles; skin smooth.

*Description of species* (from M. S. No. 3612 ♀ (756) "Siam"): Head little longer than broad, depressed, body slender; snout obtusely pointed or rather truncate anteriorly, longer than eye; canthus



FIG. 62.—*Rana alticola* Boulenger. B. M. No. 1916.6.22.29 ♀ (248). Actual snout-vent length, 52 mm. Klong Bang Lai, Prachuap Khiri Khan, Thailand.

rostralis well defined but rounding; loreal region nearly vertical, concave; width of interorbital space slightly greater than width of upper eyelid; nostril nearer to end of snout than to eye; tympanum large, distinct, its diameter slightly more than three fifths length of eye, separated from eye by distance about one third its diameter.

Vomerine teeth on short oblique ridges beginning between choanae but extending behind level of their posterior borders, separated from choanae by distance equal to length of one ridge, and from each other by a greater distance; (males with internal vocal sacs); tongue free posteriorly for about one third of its length, deeply notched behind.

Skin smooth above; narrow (in young specimens rather indistinct) dorsolateral fold from near eye to above groin; dim fold from eye to shoulder behind tympanum; chin, venter, and limbs smooth. Arms slender, tips of digits widened into strong discs each with peripheral groove; first finger a little longer than second; third little longer than snout; subarticular tubercles large and strongly prominent. Legs long, very slender, tibiotarsal articulation reaching slightly beyond tip of snout; when limbs are folded at right angles to body, heels overlap five or more millimeters; toes slender, with discs; toes webbed to discs of third and fifth digits, two phalanges of fourth free; outer metatarsals separated by web almost to tarsus; large subarticular tubercles; prominent inner metatarsal tubercle and small more or less distinct outer.

*Color:* Light brown above nearly uniform; sides somewhat darker brown; light vertebral mark above urostyle; dorsolateral fold light-edged with darker on outer side; upper lip lighter with dark margin; bars on limbs not or barely indicated; chin and venter whitish, throat dimly clouded brownish, with a white median line.

*Measurements in mm.:* Snout to vent, 39; width of head, 11; length of head, 15; arm, 22; leg, 55; tibia, 18; foot and tarsus, 20.

*Variation:* The tibiotarsal articulation may just reach the tip of snout or it may reach several millimeters beyond the tip.

The distinctness of the dorsolateral glandular fold varies and if the specimen is somewhat desiccated it may not be discernible. Occasionally there is a black line bordering the light-colored fold. The back as well as the chin and throat may have some dark-brown spots. Sometimes the lip is pink and often a white line is present on throat. The largest female specimens measure about 52 millimeters.

*Distribution:* In Thailand the species is known from Prachuap Khiri Khan, Chumphon, and Nakhon Si Thammarat provinces. Elsewhere it ranges in Assam and northern Indo-China. I believe that it has not been taken in the southern part of the Malay Peninsula.

*Remarks:* *Alticola* appears to be spotty in its distribution. From the character of the digital pads it is probably arboreal. I have not found the species in northern Thailand where the species is to be expected.

This species has a curious tadpole bearing two large paratoidlike glands on the front of the back, and a third elongate medial gland on back of rump. These glands are present also in newly-transformed young. The tail is much thickened near its base and ends in an acute point.

The name *Rana alticola* is a substitute name for *Hylorana pipiens* of Jerdon, which is preoccupied in *Rana*.

*Rana tasanæ* M. Smith

FIG. 63

*Rana pullus* (not of Stoliczka 1870) M. Smith, Journ. Federated Malay States Mus., vol. 10, 1921, p. 197, pl. 2.

*Rana tasanæ* M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 4, 1921, p. 193 (change of name); Bull. Raffles Mus., no. 3, Apr. 1930, p. 101 (Tasan and Mamoh near the Isthmus of Kra).

*Diagnosis:* Small frog (40 mm.); no dorsolateral fold; head as broad as long; canthus rostralis obtuse; tympanum present; first finger shorter than second; heel to near tip of snout; toes half webbed; inner metatarsal tubercle present, no outer. Gray or blackish above; below whitish speckled except on venter; no vocal sac; fine network of minute glandular folds on dorsum. Skin fragile.

*Description of species* (from B. M. No. 1947.22,2 (M. S. No. 3293): Small species (snout to vent, 39 mm. ♀); width of head (19 mm.) greater than length (17.2 mm.); snout oval seen from above, the nostrils separated by distance (4.3 mm.) slightly greater than interorbital distance, and this slightly greater than width of upper eyelid; canthus rostralis distinct, loreal region oblique with elongate concave area extending to and somewhat under eye; tympanum distinct, its greatest diameter (3.1 mm.) approximately half length of eye (6.05 mm.) and half snout-length (6.15 mm), separated from eye by half its diameter; skin fold extends straight back from eye then at posterior level of tympanum it extends down and back to above arm-insertion; strongly defined elongate glandular





FIG. 63.—*Rana tasanæ* M. Smith. B. M. No. 1947.2.2.82. Actual snout-vent length, 39 mm. Chumphon, Thailand. (Paratype.)

tubercle at angle of mouth extending downwards; choanae moderate in size, clearly visible seen from below, their anterior edge forming a straight line; vomerine teeth on two elevated ridges, separated from choanae by length of one ridge, extending diagonally from posterior level of choanae, separated mesially by half length of a ridge; palatal glands open through a transverse row of pores at anterior level of choanae; tongue strongly notched behind, free for about one third of its length; (male without vocal sac but with enlarged nuptial pad on first finger); fingers moderately long, first little shorter than second, tips with moderately large discs, with a deep transverse groove across front, separating the upper from the lower surface, the under part extending distinctly farther forward than upper part; no web remnant, but lateral ridges are indicated at least on inner parts of second and third fingers; sub-articular tubercles distinct, no supernumerary tubercles; strong inner metacarpal tubercle; median and outer tubercles fused, notched above and slightly elevated; leg rather short, the tibiotarsal articulation reaching front edge of eye; toes with dilated discs grooved like fingers, somewhat smaller; outer toes nearly half webbed, inner toes one-third webbed; the webs reaching discs as narrow fringes; strong subarticular tubercles; an elongate inner metatarsal tubercle; a tarsal fold; outer finger with a narrow outer fringe. Skin smooth above and below, but under skin a pronounced reticulum that leaves imprint on skin.

*Color:* Nearly uniform brown above with indication of lighter marks on upper lip, separated by darker brown; venter, upper lip, and chin with brown and cream reticulation; back part of venter cream-white. Brown under limbs with some slight flecks of cream; uniform brown under feet and tarsi.

*Measurements in mm.* (B. M. Nos. 1947.22.72, 1947.22.82): Snout to vent, 39, 24; width of head, 19, 12; length of head, 17.6, 12; arm, 24, 15; leg, 59.5, 41; tibia, 20, 14; foot and tarsus, 25.5, 19.

*Variation:* In the smaller measured specimen the vomerine ridges are smaller, closer together, and in consequence, farther from the choanae.

*Distribution:* Known only from the type locality, Tasan and Mamoh (near the Isthmus of Kra), Chumphon and Renong provinces, respectively. Not known from elsewhere.

*Remarks:* The relationship of the species is said to be with *Rana oeddolmii*. I suspect a relationship with *Rana tenasserimensis*.

The females reach a size of 40 mm.; the males 33 mm. The tympanum of male is proportionally larger than in female.

Dr. Smith comments "The skin of this frog is unusually tender. There is not a single example in the series in which the skin is not torn or damaged in some part of the body. The glandular reticulations referred to are possibly not so prominent in life as in spirit specimens."

The remarkable fact is that the species has not been found save at the type locality of Tasan, "25 miles SW of Chumporn," with the exception of a single specimen taken at Mamoh, Renong. A series of 46 were taken at the type locality.

Smith remarks: "The eggs large, few, unpigmented, the vitelline sphere measuring 2 mm. in diameter."

*Rana tenasserimensis* Slater

FIG. 64

*Rana tenasserimensis* Slater, Proc. Zool. Soc. London, 1892, p. 345, 348, pl. 24, figs. 4, 4a (type locality, Tenasserim, Burma); Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, pp. 310, 331; Proc. Zool. Soc. London, 1894, p. 641; Fea, Ann. Mus. Civ. Genova, ser. 2, 1897, p. 476 (Karin Hills); M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 102 (Khao Ram and Khao Ronpibon, Nakhon Si Thammarat).

*Micrixalus tenasserimensis* Myers, Proc. Biol. Soc. Washington, vol. 55, 1942, p. 79.

*Cornufer tenasserimensis* Boulenger, Ann. Mag. Nat. Hist., ser. 9, vol. 1, 1918, p. 373; Bourret, Les batraciens de l'Indochine, 1942, p. 378.

**Diagnosis:** A small frog (25 mm.); vomerine teeth normally absent; tympanum distinct, half of eye diameter; first finger shorter than second. Toes webbed at base; outer metatarsals bound together; feeble inner metatarsal tubercle; usually dorsolateral light stripes from eye; skin everywhere glassy smooth; digital discs large, without a transverse groove; tongue bifid behind.

**Description of species** (from M. S. 6258. B. M. No. 1927.4.21.1-4): Small frogs with short broad snout; nostril little nearer median point on snout than to eye; tip of snout projecting little beyond lower jaw; canthus rostralis obtuse, loreal region nearly vertical, concave; distance between nostrils distinctly greater than inter-orbital width, which is distinctly greater than width of an upper eyelid; tympanum distinct, its diameter equal to about half length of eye, separated from eye by distance equal to one third its diameter; indistinct fold from eye curves above tympanum, terminating, somewhat thickened, above arm-insertion; a small glandular fold beginning below tympanum turns down in front of arm-insertion terminating near its lower level.



FIG. 64.—*Rana tenasserimensis* Selater. B. M. No. 1927.4.21.1-4 (M. S. 6258). Actual snout-vent length, 24 mm. Khao Ronpibon, Nakhon Si Thammarat, Thailand.

Palate high, choanae rather small, largely, if not entirely hidden when palate is viewed directly from below; no trace of vomerine teeth; tongue rather large, strongly notched behind with small posteriorly directed lobule (pigmented) just below notch; apparently distinct transverse fold just behind level of Eustachian tubes; openings of tubes distinctly larger than choanae; openings of palatal glands medial, between choanae. Arms rather short, wrists not reaching tip of snout; fingers elongate with well-developed terminal discs, width of those on outer fingers more than half diameter of tympanum; transverse terminal groove on discs but no transverse groove on face of disc. Two rather large, flat metacarpal tubercles; no supernumerary tubercles; first and second fingers equal or second slightly longer; no trace of web, and no trace of lateral folds or ridges on sides of fingers. Toes with widened discs, some almost if not entirely as large as those on fingers; trace of web between toes, but no folds or lateral ridges; small low inner

metatarsal tubercle, no outer; a fine scarcely distinguishable fold follows behind tubercle, and a fine fold along outer metatarsal which may extend somewhat on tarsus; outer metatarsal united with others throughout its length; tibiotarsal articulation extends two millimeters beyond tip of snout; when legs are folded at right angles to body heels overlap one or two millimeters; subarticular tubercles on all digits rather large, flat, indistinct.

Skin smooth without trace of tubercles, warts or granules on body; under lens one may observe a very fine elevated reticulum of smooth folds covering dorsal surfaces of head, body, and limbs (in some specimens it is heavier and more distinct and may be seen without lens).

*Color:* Above gray or grayish brown with entire dorsal surface of snout uniform light-gray; a blackish-brown mark across head covering posterior half of upper eyelids; a pair of gray-white stripes from corner of eyes running back to near groin widening a little on sides of rump; area between stripes flecked or with small brownish blotches; brown canthal stripe; upper jaw with conspicuous brown and cream spots; sides of head, neck, and sides with small flecks and blotches of brown; legs and arm barred above with brown; back surface of thighs brownish; below gray-white with brownish dots or flecks on lower jaw and chin.

Measurements in mm. of *Rana tenasserimensis*

Number.....	6258	6259	6103	6267
Sex.....	♀	♀	♀	♀
Snout to vent.....	24	23	25	24
Width of head.....	10	9.6	10	9.6
Length of head.....	8.8	8.2	8.3	8
Arm.....	15.4	14.2	13	14.9
Leg.....	44	41	38	41.6
Tibia.....	14.4	13.9	13	14
Foot and tarsus.....	19.2	17.1	16	19

*Variation:* The type of the species is figured as having vomerine teeth. There is no trace of teeth in the four females here examined.

In color and markings, No. 6259 is similar but the dorsal spotting is more intense, the markings emphasizing two dorsal spots and one between eyes; the dorsolateral light lines are interrupted; Nos. 6103 and 6267 are distinctly brownish with deep-brown markings.

*Distribution:* This species is known in Thailand from a collection made at Khao Ram and Khao Ronpibun, Nakhon Si Thammarat by Dr. Malcolm Smith. Elsewhere the species is known in Burma.



*Remarks:* The breeding habits of this species are not known. The ovaries of each female studied contained either two or three large, presumably nearly mature eggs measuring about 2.5 millimeters in diameter. In the same ovaries were several eggs of about half this size and still others somewhat smaller. It suggests that only very few eggs are deposited at one time and that perhaps there are two or more layings in one season.

I did not discover the species while collecting in this area. The numbers given are those of Malcolm Smith; the group number being B. M. 1927.4.21.1-4. There has been considerable difficulty in placing this small frog generically. Slater described it as a *Rana*; Boulenger considered it as a member of the genus *Cornufer*; Myers has suggested (with a ?) that it is *Micrixalus*. M. Smith has placed it in a subgenus *Discodeles* in *Rana*. In this I follow Smith since I do not have sufficient comparative material at hand to make an independent decision.

### *Rana jerboa* (Günther)

FIG. 65

*Hylorana jerboa* Günther, Proc. Zool. Soc. London, 1872, p. 599, pl. 40, fig. B (type locality, Matang, Sarawak, Borneo).

*Rana jerboa* Boulenger, Catalogue of the Batrachia Salientia s. Ecuadata in the British Museum, 1882, p. 67; Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, p. 335; Proc. Zool. Soc. London, 1893, p. 526; Flower, *ibid.*, 1899, p. 916; Butler, Journ. Nat. Hist. Soc. Bombay, vol. 15, 1903, p. 199; van Kampen, Natuurk. Tijdschr. Ned.-Ind., vol. 69, 1909, p. 39, pl. 2, figs. 3-6; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 244-245; Boulenger, Rec. Ind. Mus., vol. 20, 1920, p. 196; Mertens, Arch. für Hydrob. Suppl. Band, 12, 1934, p. 685 (Sumatra); van Kampen, the Amphibia of the Indo-Australian Archipelago, 1923, p. 208 (Siam); M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 109; Metcalf, Proc. U. S. Nat. Mus., vol. 87, 1940, p. 568 (Siam).

*Rana masonii* Boulenger, Ann. Mag. Nat. Hist., ser. 5, vol. 13, 1884, p. 397.

*Staurois jerboa* Bourret, Les Batraciens de l'Indochine, 1942, pp. 382-385, figs. 123, 124.

*Diagnosis:* Large frogs reaching a snout-to-vent length of 102 mm.; nostril equidistant between eye and end of snout; discs of fingers and toes smaller than tympanum; first and second fingers nearly equal; tibiotarsal articulation reaches more than centimeter beyond tip of snout; tip of femur reaches tympanum; pair of small vocal sacs near jaw-angles; toes nearly fully webbed; two metatarsal tubercles, no tarsal fold.

*Description of species* (from EHT-HMS No. F. 1045, Java): Head longer than broad, body relatively slender; snout rather obtusely pointed; canthus rostralis distinct; loreal region concave,



FIG. 65.—*Rana jerboa* (Günther). Type (after Günther 1872). Actual snout-vent length, approximately, 51 mm., Matang, Borneo.

sloping obliquely to lip; nostril midway between eye and tip of snout; tympanum very distinct, slightly sunken; strong rims about tympanum, which stands very close to eye; diameter of tympanum about two thirds length of eye; eyelid considerably wider than interorbital distance; choanae large, vomerine teeth on two oblique ridges almost completely between choanae, separated by a distance about equal to their distance from choanae; palatal glands open into straight groove between anterior edges of choanae; male with internal vocal sacs; tongue free for about a third of its length.

Skin on dorsum finely granulate or corrugate; a dorsolateral glandular fold from eye to end of rump; small fold running from above tympanum to point near arm-insertion; undersurfaces smooth except mesial portion of femur and area about vent granulate.

Digit-tips expanded into discs which are smaller than tympanum; first finger little longer than second; much enlarged tubercle at base of first finger; two other rather rounded smaller metacarpal tubercles. Toes almost fully webbed to discs; subarticular tubercles well developed on hand and foot; outer metatarsals separated by a web; an inner metatarsal tubercle; no outer; no tarsal fold; tibio-tarsal articulation reaches far beyond tip of snout; length of tibia nearly four fifths of head-body length.

*Color:* Generally brownish with some darker marbling; sides dark brown including a light streak along upper lip; limbs with indistinct dark crossbars; ventral surfaces whitish, nearly uniform.

*Measurements in mm.:* Snout to vent, 35; width of head, 13; length of head, 16.5; arm, 29; leg, 91; tibia, 29; foot and tarsus, 38.

*Variation:* The vomerine teeth may extend behind level of choanae; the interorbital width may exceed the width of an upper eyelid and the first two fingers may be of equal length. Some specimens have the chin, breast, and venter spotted.

*Distribution:* The inclusion of this species in the Thai fauna is based on two "records." Van Kampen mentions Siam as part of its range (based on what record?) and Metcalf reports a parasite from a specimen of *Rana jerboa* from Trong [= Trang] Lower Siam.

Elsewhere the species is known in Burma, Malaya, and the larger East Indian islands of Borneo, Java, and Sumatra.

*Remarks:* I have examined the type in the British Museum. The specimen measures 55 mm. It is a female with eggs. The first finger is longer than second. The loreal region is nearly vertical, but somewhat concave, the discs on digits are slightly pointed

rather than rounded. When the leg is adpressed forward the knee reaches the front of tympanum, and the tibiotarsal articulation reaches beyond the tip of the snout a distance equal to half the length of the femur.

Günther describes the color: "Upperside of the head and back red, side of the body and head black, upper lip and glandular folds greenish white, legs marbled with brown; lower side of foot and tarsus black; abdomen whitish."

All trace of the red and greenish color is now absent.

*Rana hosii* Boulenger

FIG. 66

*Rana hosii* Boulenger, Ann. Mag. Nat. Hist., ser. 6, vol. 8, 1891, p. 290 (type locality Borneo, Mt. Dulit); Journ. Federated Malay States Mus., vol. 3, 1908, p. 62; van Kampen in Weber, Zool. Ergeb. Reise Nied. O-Ind., vol. 14, 1907, p. 398; Bull. Dept. Agric. Ind. Neerl., vol. 25, 1909, p. 2. Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 243-244; van Kampen, Notes Leyden Mus., vol. 36, 1914, p. 260; Boulenger, Rec. Ind. Mus., vol. 20, 1920, pp. 199-200; M. Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 274 (Gunong Tahan Mt., Malaya); van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, pp. 215-216, fig. 25 (the drawing seemingly shows the snout too pointed).

*Rana durheimi* Baumann, Zool. Jahrb., Syst., vol. 34, 1913, p. 275, text figs. D and E.

*Rana cataracta* M. Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 274 (Nakhon Si Thammarat, Thailand; Fraser's Hill, Malaya); Bull. Raffles Mus., no. 3, 1930, p. 110 (places *cataracta* in the synonymy of *hosii*).

*Hyla chalconotus* (part.) Schlegel, Abbildungen neuer oder unvollständig bekannter Amphibia 1837-44, p. 23, pl. 9, fig. 1.

**Diagnosis:** A large frog (snout to vent 97 mm.); tympanum less than half diameter of eye; first finger longer than second; discs on two outer fingers as large as tympanum; foot fully webbed except on fourth toe; low elongate inner metatarsal tubercle; no outer tubercle; tibiotarsal joint reaching to a point considerably beyond tip of snout; white stripe on upper lip; dorsolateral fold distinct; tympanum with median dark spot surrounded by lighter circle. Back may be black spotted or green.

**Description of species** (from No. 33816 ♀ Doi Suthep, 4000 ft. elev., Chiang Mai): Snout subacuminate as long as orbit, projecting slightly beyond mouth; nostrils separated by an interval equal to interorbital space, slightly nearer tip of snout than to eye; canthus rostralis evident but obtuse or rounded; loreal region deeply concave, sloping obliquely to lip; tympanum sharply delineated, diameter (5 mm.) less than half length of eye (11.5 mm.), separated from eye by distance equal to its diameter; eyelid (8.5 mm. wide)



FIG. 66.—*Rana hosii* Boulenger. No. 33816 ♀. Actual snout-vent length, 96 mm. ♀. Doi Suthep, circa 4000 ft. elevation, Chiang Mai, Thailand.

about equal to interorbital distance; frontal, interorbital, and occipital areas slightly depressed or concave.

Vomerine teeth on two strongly elevated oblique ridges beginning near inner anterior edge of choanae and extending half their length behind posterior level of choanae; openings of palatal glands in transverse line closer to front of palate than to anterior level of choanae; tongue large, wide, strongly bifid behind, free for one third of its length.

Arm long; first finger longer than second; all digits moderately long, tips widened into large terminal discs each with peripheral groove but without a groove across ventral surface of disc; discs of outer fingers as large as tympanum; upper part of disc larger



than lower, rather pointed; subarticular tubercles well developed. Leg very long, toes webbed to widened discs; an elongate inner metatarsal tubercle more than a third length of inner toe; no outer tubercle; tibia two thirds of snout-vent length. Subarticular tubercles on toes, distinct, elongate. A feeble tarsal fold. Heels overlap considerably when legs are folded at right angles to body. Skin of head, dorsum, and sides slightly granulate; limbs, chin, and venter smooth; dorsolateral folds distinct; a few large granulations on sides of vent and on median area of underside of thigh.

*Color:* Upper surface of head dark olive, dorsum and sides brown; lighter low on sides with few rounded brown spots more or less outlined in dull cream; arms and legs with bands separated by narrow lines of yellow-brown; back of thigh brown with veriform cream or yellowish-brown marks; chin, venter, and underside of limbs cream-white; whitish or cream line on upper lip; whitish spot behind angle of jaws; underside of web on foot dark brown; tympanum fawn with dark brown center.

*Measurements in mm.:* Snout to vent, 96; width of head, 35; length of head, 37; axilla to groin, 38; arm, 58; leg, 194; tibia, 62; foot and tarsus, 76.

*Variation:* The male of the species has internal vocal vesicles, and a nuptial pad on the first finger. Malcolm Smith described his *Rana cataracta* (which he later placed in the synonymy of *R. hosii*) as verdant green above in life, grayish in spirits. The sides of the head and body a little darker than back. Upper lip and glandule behind it, white. The lower parts white.

A specimen from Tahan River, Malaya has the tibia exactly the length of the head and body. The eye length is nearly equal to the length of the snout in adult specimens. Females are very considerably larger than males, the largest specimen recorded measuring 104 millimeters from snout to vent. Boulenger (1912) states "first finger not extending beyond second," and "tibia not two thirds the length of head and body."

*Distribution:* The specimens here recorded are presumably the first taken in northern Thailand. This record extends the range in Thailand some 900 km. northward.

In southern Thailand the species has been taken on Khao Ram in Nakhon Si Thammarat (*Rana cataracta*) and at Tasan, Chumphon province. In Malaya it has been taken on Gunong Tahan and at Fraser's Hill. It is known also from Borneo, Java, and Sumatra.

*Remarks:* M. Smith states that the voice of the male, heard only at night is a short whistling cry, sometimes almost a scream. My own experience shows them to be extremely shy. They are perched on rocks or low shrubs along mountain rivulets or streams and dive into water to escape, taking temporary shelter under submerged rocks or perhaps as frequently entering holes in the banks.

Differences in the populations may be indicative of subspecies; however the material available does not permit me to make judgment on the matter. The males and the young specimens look similar to *Rana chalconota* and may be easily mistaken.

*Rana livida* (Blyth)

FIG. 67

*Polypedates lividus* Blyth, Journ. Asiat. Soc. Bengal, vol. 24, 1855, p. 718 (type locality, Eastern Himalayas).

*Polypedates chloronotus* Günther, Proc. Zool. Soc. London, 1875, pp. 569-570, pl. 65, fig. A (entire animal in color) (type locality, "Darjeeling").

?*Polypedates smaragdinus* Jerdon, Proc. As. Soc. Bengal, 1870, p. 83; Anderson, Proc. Zool. Soc. London, 1871, p. 208.

*Rana chloronota* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum 1882, p. 69, Werner, Abb. Bayer. Akad. Wiss., Ed. 22, Heft. 2, 1903, pp. 369, 376.

*Rana livida* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 5, 1887, p. 484; The fauna of British India . . . Reptilia and Batrachia, 1890, p. 462 (Assam, Tenasserim and Hongkong); Butler, Journ. Nat. Hist. Soc. Bombay, vol. 15, 1903, p. 201 (Larut District, Perak); Boulenger, The fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 244-245; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, May, 1917, p. 229 (Doi Nga Chang, N. Siam); Boulenger, Rec. Ind. Mus., vol. 20, 1920, pp. 214-216; M. Smith, Proc. Zool. Soc. London, 1921, p. 437; Bull. Raffles Mus., no. 3, 1930, p. 110 (Nakhon Si Thammarat mountains; Believes *graminea* Boulenger a synonym).

*Rana graminea* Boulenger, Proc. Zool. Soc. London, 1899, p. 958, pl. 67, fig. 1. *Rana (Hylarana) livida* Bourret, Instr. Publ., Hanoi, no. 22, 1941, p. 31.

*Diagnosis:* Tips of digits moderately dilated, first finger longer than second, much swollen at base; pair of vocal sacs in front of arms; tympanum large, distinct, toes four-fifths to fully webbed; small elongate inner metatarsal tubercle, no outer; back of thigh black with numerous white spots.

*Description of species* (from No. 34958): Head oval, depressed but not concave; canthus rostralis somewhat obtuse; loreal region slightly oblique, distinctly concave; nostril equidistant or slightly nearer tip of snout than to eye. Upper eyelid distinctly wider than interorbital space, snout longer than eye; tympanum large, distinct, its diameter (5 mm.) little more than half of eye-length (9 mm.).

Tongue very slender, elongate, notched behind, free for about a



FIG. 67.—*Rana livida* (Blyth). No. 34957 ♂. Actual length, snout-vent, 71 mm. Phu Kading, Loei, Thailand.

fourth of its length; vomerine teeth on two ridges beginning between choanae that extend back diagonally to a point somewhat behind choanae, separated mesially by a distance much less than their distance from inner side of choanae; palatal glands open through a series of discernible parallel tubes into a sinuous groove anterior to level of choanae but closer to them than to anterior limit of palate; a curved or sinuous vocal slit near mouth-angle

opens into each lateral external vocal sac which is situated directly in front of arm; openings of Eustachian tubes considerably larger than choanae.

Forearm thickened; first finger equal or a little longer than second, its base much swollen with a large patch of nuptial asperities covering swelling; tips of digits widened into discs equal to about half width of tympanum; largest 3 mm. wide, with deep groove about periphery but none on ventral surface; second and third fingers with trace of lateral ridge or fringe; no trace of basal web; legs elongate, tibiotarsal articulation reaching about ten millimeters beyond tip of snout; toes four-fifths to fully webbed; outer metatarsal separated completely by web; when legs are folded at right angles to body, heels overlap about eight millimeters; sub-articular tubercles distinct under fingers and toes; two outer metacarpal tubercles faintly outlined; a small elongate inner metatarsal tubercle, no outer; no tarsal fold.

Skin smooth above, below, and on sides; a slight glandular ridge follows from eye to behind jaw-angle thickening into a distinct gland, followed by a second gland above arm; an indistinct dorso-lateral fold; patch of flat granules on underside of femora and about vent. No trace of dorsal granulation or lateral tubercles or warts.

*Color in life:* Entire dorsal surface bluish green; sides black with some white marks especially in groin; ventral surfaces gray-white. A whitish line on upper jaw, becoming yellowish cream posteriorly; inner finger gray-white; arm with dim banding above, its underside with some whitish spots or flecks; femora and tibia banded brown, with lighter interspaces; front and back faces of femora, and part of upper surfaces black; undersurface of tibiae blackish, with scattered small rounded or vermiform white spots; side of foot blackish.

*Variation:* The three males listed above, all from Phu Kading,\* Loei Province, are larger than any in the series of male specimens in the British Museum (males, 45-51 mm., females, 84 to 100 mm.) as measured by Boulenger (1920).

The size of the digital discs is considerably smaller than suggested for *R. livida* by Boulenger (1920): "very large discs as long as broad, as large or a little smaller than the tympanum."

It is possible that specimens from this isolated mountain top should be regarded as a subspecies of *livida*.

*Distribution:* The species originally described from northern

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\* Phu Kading = Mountain of the cowbell, *i. e.*, shaped like a cowbell.

Measurements in mm. of *Rana livida*

Number.....	34956	34957	34958
Sex.....	♂	♂	♂
Snout to vent.....	70	71	65
Width of head.....	24	27	22.8
Length of head.....	24	25	21
Length of snout.....	10	10	9
Eye.....	9	9	8.7
Arm.....	45	45	43
Leg.....	131	126	125
Tibia.....	47	42	42
Foot and tarsus.....	57	55.5	54
Diameter of largest disc.....	3	2.6	2.95

India has been found in Chiang Mai (Doi Nga Chang), and in Loei province (Phu Kading).

Outside of Thailand the species is known in northern India (eastern Himalayas), Assam, Burma; Perak, Malaya; ?southern China; and Indo-China.

*Remarks:* There has been considerable confusion concerning this species, and a recent treatment by Bourret has placed in its synonymy, *Rana graminea* Boulenger, from Hainan, *Rana leporipes* Werner, and, with a question, Ahl's *Rana (Hylorana) sinica*, from southern China. It is evident that there are certain differences in these populations referred to *R. livida* in the area from Assam east to Hainan and south to Perak. Whether they merit taxonomic designations must await a careful review of the types and materials available.

*Rana scutigera* Andersson

*Rana scutigera* Andersson, Kungl. Svenska Vetensk-akad. Hand., Band 55, no. 4, 1916, pp. 15-17 (type locality, Hat Sanuk, Siamese Malaya, near Tenasserim border); M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, May 1917, pp. 229 (near Koh Lak, S. W. Siam?); Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, 1958, p. 1039 (listed).

*Diagnosis:* Small frog, snout to vent, 49 mm.; vomerine teeth between choanae not extending behind them; skin on head partly ossified with large square plate between eyes, extending to level of posterior edge of tympanum; a plate on side of snout and a small one above tympanum.

*Description of species* (type description): "Vomerine teeth in two very distinct oblique series between the choanae, not reaching behind the posterior edge of the latter; the space between the groups of teeth larger than their distance from the choanae. Head



depressed, as broad as long; snout rounded, a little longer than diameter of eye; canthus rostralis distinct; loreal region oblique, concave nostril much nearer the tip of the snout than the orbit; interorbital space broader than an upper eyelid; tympanum very distinct, two-thirds the diameter of the eye. Fingers and toes slender with well-developed discs; disc of the first fingers considerably smaller than those of the other fingers; first finger not reaching the tip of the second, toes broadly webbed, the formula being 1, 2/1, 2 1, 2/2, 1 (the figures indicate the joints free from web, above the line on the inner, below the line on the outer side, counting from the first toe). A small inner metatarsal tubercle, no outer. If the dimension of the tibia is marked off from the knee forwards along the body, it reaches the tip of the snout. Skin above partly ossified, *viz.*, a large square plate between the eyes, extending from their anterior margin to the level of the posterior edge of the tympanum, two semicircular plates on the snout, forming canthi rostrales, and two very small plates, one above each tympanum. A narrow glandular fold from the eye above the tympanum to the anterior part of the side of the body, where it disappears; remaining upper surfaces smooth; belly coarsely, under surfaces of thighs moderately granulate.

"When alive this frog was pretty yellow; when caught it grew rapidly paler, and the yellow nearly disappeared. In spirit the ground color is whitish gray with faint dark markings on the back and more distinct ones on the sides; immediately behind the interorbital osseous plate a large angular spot, the branches of which vanish before the middle of the bar; on the sacral region of the back some small distinct black spots. A blackish brown band from the tip of the snout bordering the canthus rostralis, extends along the edge of the upper eyelid of the tympanum, and of the glandular fold to behind the axil; behind the tympanum this band is rather broad, sharply limited above and below; on the loreal region only its upper margin is well defined, while the lower fades into the light margin of the upper lip; on the sides of the body some small distinct rounded black spots. The hind limbs with faint dark cross bands; the hinder side of the thighs reticulated with dark and light. Lower parts uniform dirty yellowish white, the chin white. The toes are blackish brown.

"One specimen, a male from Hat Sanuk the Siamese Malaya near Tenasserim boundary, 12/2/15, caught on a cactus, dermal fold above axil possibly indicate outer vocal vessicles."

*Measurements in mm.:* "Total length (from snout to vent), 48 mm. Breadth of head, 17; Length of head to hind margin of tympanum, 17.5; Length of snout, 7.8; Diameter of eye, 6 mm.; Diameter of tympanum, 4.2; Length of humerus, 10; Elbow to tip third finger, 24; Length of femur, 27; Length of tibia, 27; Length of tarsus and 4th toe, 3.5."

"In spirit this specimen corresponds very well with the figure of *Rana graminea* Boul. from Hainan (PZS London, 1899, pl. 67) and evidently this new species is nearly allied to that one as well as *Rana labialis* Boul. from the Malay Penn. It is, however, easily distinguished by the bony shields, the coloration, the strongly granulate keel, etc."

*Remarks:* The description of this frog parallels so closely the characters of *Rhacophorus leucomystax* that I cannot but fear that the two are the same. Thus a specimen of *leucomystax* measuring 48 mm. (the length of the type of *Rana scutigera*), was compared with the measurements given for *scutigera*. The individual measurements differed about one to two millimeters.

The presence of the granular vent and the rapid changing of colors suggest *Rhacophorus* rather than *Rana*.

Anyone having access to this type specimen should ascertain whether it is *Rana* or *Rhacophorus* and if the latter, compare it with young male specimens of *leucomystax*.

#### Genus STAUROIS Cope

*Staurois* Cope, Nat. Hist. Rev., 1865, p. 117 (Cope states: "Embraces *Ixalus natator*, *Ixalus guttatus* and *Hyperolius plicatus* of Günther." Boulenger (1918) designates the first, *Ixalus natator* as the type): Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata . . . British Museum, 1882, p. 7; Ann. Mag. Nat. Hist., ser. 9, vol. 1, 1918, pp. 374-375; Noble, Ann. New York Acad. Sci., vol. 30, Oct. 31, 1927, pp. 107-108, fig. 27; The biology of the Amphibia, 1931 (reprint 1954) pp. 65 (fig. 23), 521-522.

*Amolops* Cope, Nat. Hist. Rev., 1865, p. 117 (type of genus *Polypedates afghanus* Günther).

*Diagnosis:* Outer metatarsus webbed to base; terminal phalanges slender with short transverse limb; tongue with median inferior prominence; no dorsolateral folds; vomerine teeth; ethmoid widely separating prefrontals, and these from frontoparietals.

Cope defined *Amolops*: "Terminal phalanges short; transverse limb long; tongue without median inferior prominence; no dorsolateral glandular folds; vomerine teeth."

Boulenger synonymized these genera with *Rana* in 1882 where they remained for some decades. Boulenger in 1918 redefined the genus. The characters designated were: Vomerine teeth present

or absent; tympanum small; finger discs large, broader and larger than those on toes with a half-disc within the disc on the lower surface; toes fully webbed involving the base of discs; outer metatarsals separated to base. He included *Staurois larutensis* Boulenger, *Staurois natator* Günther, *Staurois nubilus* Mocquard, *Staurois tuberilinguis* Boulenger, and *Staurois guttatus* Günther.

Noble in 1931 reviewed the group and in a measure reinterpreted the genus. He says: "It is, therefore, advisable to redefine the genus *Staurois* in order that it may include all species having this same distinctive tadpole." Besides the forms listed above, Noble includes *Rana whiteheadi*, *livida*, *cavitympanum*, *hosii*, *jerboa*, *afghana*, *ricketti*, *hainanensis*, and perhaps others.

It is indeed difficult to decide on the limits of the genus *Staurois*. I am aware that there is no more reason why two different genera might not have tadpoles with the suction discs as described for *Staurois* than to have two different genera lacking the suction disc, provided they differed also in other characters.

Since specimens of both groups are dealt with in this work I am considering *larutensis* and *afghana* as representing the genus *Staurois*. It is possible that *livida* and *hosei*, among Thai species, should be considered with *Rana* as has been done by Malcolm Smith (Bull. Raffles Mus., no. 3, 1930, pp. 110-111). He points out that suckers have developed on tadpoles in other genera in other parts of the world. He seems to suspect that some tadpoles of these Asiatic frogs may have been incorrectly identified.

#### KEY TO SPECIES OF STAUROIS IN THAILAND

- Vomerine teeth on two strong diagonal ridges between and partly behind back level of choanae; no groove across the under face of the dilated discs of fingers and toes ..... *afghana*  
 Vomerine teeth in two small low rounded patches between and extending behind choanae; a deep groove across undersurface of digital discs, ..... *larutensis*

#### *Staurois afghanus* (Günther)

FIG. 68

*Polypedates afghana* Günther, Catalogue of the Batrachia Salientia in the collection of the British Museum 1858 (1859), p. 81 (type locality Afghanistan *ex errore?*); Fauna of British India, 1884, p. 432.

*Amolops afghanus* Cope, Nat. Hist. Rev., 1865, p. 117.

*Rana afghana* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd Ed., 1882, pp. 69-70; Ann. Mus. Civ. Genova, ser. 2, vol. 5, 1887, p. 485; Annandale, Rec. Ind. Mus., vol. 8, 1912, p. 24, pl. 4, fig. 3 (tadpole).

*Rana latopalmata* \* Boulenger, Catalogue of the Batrachia Salientia . . .

\* Boulenger's persistent refusal to use Günther's name *afghanus* is very probably on the grounds of inappropriateness. The type specimen did not come from Afghanistan.

1882, p. 464 (type locality, Tenasserim); The fauna of British India . . . 1890, pp. 462-463; Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, p. 337; Proc. Zool. Soc. London, 1893, p. 526, pl. 43, fig. 3; Cochran, Proc. U. S. Nat. Mus., vol. 77, 1930, p. 5 (Doi Angka, Thailand. This is the first Siamese record for this species).

*Staurois afghanus* Pope and Boring, Peking Nat. Hist. Bull., vol. 15, 1940, pt. 1, p. 47; Liu, Fieldiana Zool. Mem., vol. 2, 1950, pp. 358-359.

*Diagnosis:* Large *Staurois*, toes fully webbed, webs reaching onto terminal discs; discs of fingers widened, those on outer fingers larger than those on inner; discs on toes large, outermost smallest; first finger little shorter than second; a strong nuptial gland on first finger and a gland on inner side of elbow in male. Vocal sac present, the small rounded openings of sacs on floor of mouth back at level of mouth-angle; vomerine teeth lying between and behind small choanae; tongue very large, free for half its length, and on sides.

*Description of species* (from No. 71 Mai Salat, 4000 ft. northern Chiang Mai province): Snout short, canthus rostralis strongly defined, loreal region slightly concave, nostril about midway between eye and tip of snout; tip of snout rounded in profile; eyes elevated, width of an eyelid little greater than interorbital width; tympanum small, rather indistinct, its diameter about one fourth length of eye (9.8 mm.); eye very nearly equal length of snout; small fold from eye runs diagonally to near arm-insertion.

Vomerine teeth on two diagonal ridges beginning at about level of choana but separated from choanae by distance equal to three-fifths length of one series, the two series narrowly separated mesially; palatal glands open into straight but short groove near anterior level of choanae; tongue very large, wide, notched behind, free for half its length as well as along sides (male with small puckered vocal openings, on level with mouth-angle); top of head rather flattened. Skin of dorsum finely granular or shagreened; venter generally smooth as is ventral and posterior part of thigh; a few granules on posterior and dorsal faces of thigh; tibia with some fine elongated ridges.

Fingers moderately long widened into large discs with groove around periphery but no groove on undersurface of disc; first and second fingers equal; slight fringe on distal portions of two middle fingers; toes fully webbed, web reaching sides of digital discs. Outer metatarsal separated by web; subarticular tubercles well developed, elongate; flat inner metatarsal tubercle; no outer tubercle; tibiotarsal articulation reaching six millimeters beyond tip of snout; when legs are folded at right angles heels overlap five millimeters.

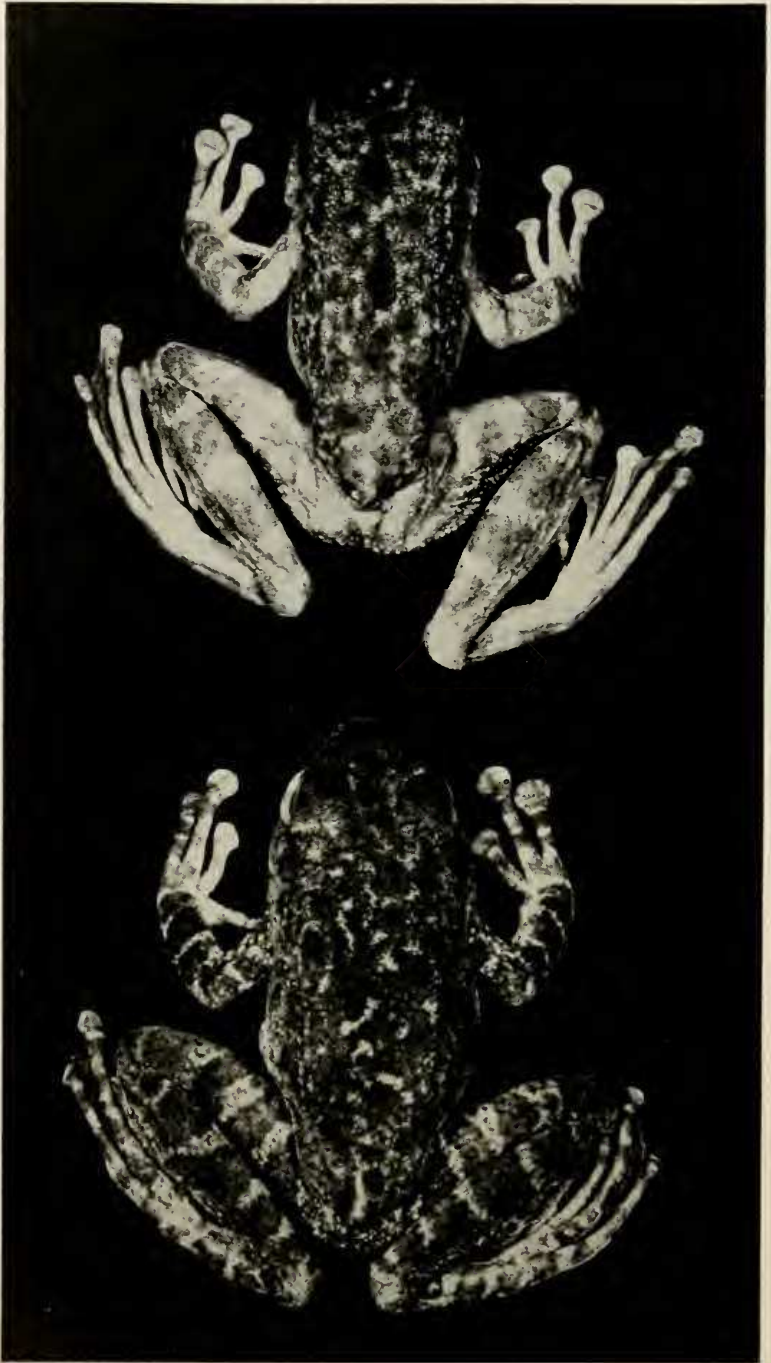


FIG. 68.—*Staurois afghanus* Günther. Upper, No. 33807 ♀, snout-vent length, 76 mm. Lower, No. 33805 ♀, 77 mm. Both, Doi Suthep, Chiang Mai, Thailand, 2300-4000 ft. elevation.



*Color in life:* Greenish olive with light reticulation enclosing darker areas; arms, hands (partly) banded with whitish; narrow light line and dark stripe on underside of forearm; legs with lighter bars which are themselves spotted black; back of thigh black with whitish reticulation; underside of foot and tarsus, and web between toes blackish; underside of discs gray. Venter yellowish cream.

Measurements in mm. of *Staurois afghanus*

Number.....	71	33805	33807	73	72
Sex.....	♀	♀	♀	♂	♂
Snout to vent.....	77	77	76	42.5	42.5
Width of head.....	29	30.5	29	17	17
Length of head.....	24	27	25	15	15
Snout.....	11	11.6	10.8	5.9	5.8
Arm.....	49	50	48	29.5	32
Leg (from vent).....	132	133	128	73	75
Tibia.....	42	45	45.3	24	25
Foot and tarsus.....	56.2	55	55	31	32

*Variation:* Although much smaller, the two males seem to be mature since the nuptial pads on first fingers are large and the arm glands are well-developed. The granulation of the back and sides is conspicuous and there is more granulation on the limbs than in females.

*Distribution:* The first record of the species for Thailand is that by Dr. Doris Cochran in 1930, for Doi Angka (Doi Intanon), Chiang Mai province. This is the highest mountain in the country.

Elsewhere the species is known in Burma, Sikkim and Yunnan.

### *Staurois larutensis* (Boulenger)

FIG. 69

*Rana larutensis* Boulenger, Ann. Mag. Nat. Hist. ser. 7, vol. 3, 1899, p. 273, pl. 11, fig. 1 (type locality, Larut Hills, Perak); Flower, Proc. Zool. Soc. London, 1899, p. 898; Laidlaw, Proc. Zool. Soc. London, 1900, p. 886, pl. 57, figs. 3 and 4; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 200; Boulenger, Journ. Federated Malay States Mus., vol. 3, 1908, p. 63; A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 245-246; M. Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 277; Bull. Raffles Mus., no. 3, 1930, pp. 110-111, fig. 6 (Tapli and Tasan, Isthmus of Kra; Ban Chanaha and Bhetong, Yala).

*Diagnosis:* A large species reaching 75 mm. snout-to-vent length; skin finely granular with some larger pustules on dorsum and about vent; eyes large, elevated upper lid wider than interorbital space; tympanum small (occasionally hidden), first finger shorter than second. Toes completely webbed; very large terminal discs, those

of fingers largest, tending to be triangular rather than rounded. Vomerine teeth in groups between choanae but each much smaller than choana. Heel to beyond tip of snout. Above pale green, strongly spotted with black.

*Description of species* (from M. S. No. 61 "Patani, Siam"): Head rather short, about as long as broad, snout somewhat rounded, sub-acuminate, and shorter than eye; loreal region nearly vertical, concave; nostril equidistant from tip of snout and eye; canthus rostralis



FIG. 69.—*Staurois larntensis* Boulenger. No. 61 ♂. Snout-vent length, 41 mm. Pattani, Thailand.

with sharp edge; interorbital space equal or little less than width of upper eyelid; tympanum well developed, its diameter equal to one third length of eye, not encroached upon by supratympanic fold, separated from eye by distance equal to two thirds its diameter.

Vomerine teeth in small elevations between and almost entirely behind posterior level of choanae; tongue free for at least one fourth its length; two small vocal vesicles, openings back near level of mouth-angle; openings of palatal glands in a short curved groove between choanae.

Skin with fine granulations with some flat enlarged pustules on sides; venter largely covered with granules or areolae; part of ventral and posterior faces of thigh with irregular granules or pustules; chin, throat and breast smooth.

Fingers with tips dilated into large discs which are considerably larger than tympanum; peripheral grooves, and groove across face of disc present; first finger shorter than second bearing large nuptial pad at base of first (males only); toes very broadly webbed, web reaching terminal discs, which are little smaller than those on fingers; an elongate but flattened inner metatarsal tubercle and small distinct rounded outer tubercle.\*

Tibiotarsal articulation reaches beyond tip of snout; when legs are folded at right angles to body, heels overlap three to four millimeters; very indistinct dorsolateral fold beginning behind eye can be traced to near groin.

*Color:* Above pale greenish (brown in fixative) with a reticulum of cream enclosing darker areas; arms and legs with transverse bars of darker color; underside of head and body whitish to yellowish white; limbs greenish to grayish; hands and feet purplish, the web nearly black.

*Measurements in mm.* (Nos. 61 ♂ and 1336 ♀): Snout to vent, 41, 54; width of head, 14, 18.8; length of head, 14.2, 18.2; arm 24.6, 36.5; leg, 67, 99; tibia, 23, 32.5; foot and tarsus, 29, 43.

*Variation:* The female of the species reaches a length of 70 millimeters, while the male is much smaller (45 millimeters). The tympani of the female specimens are definitely less than a third the length of the eye, and their diameter is less than their distance from eye. The vomerine teeth are more distinct and the outer metatarsal tubercle is distinctly developed in the female specimens.

*Distribution:* The species is known from Pattani, Yala, and

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\* Boulenger (1912) description of this species says "no outer metatarsal tubercle."

Chumphon provinces, peninsular Thailand. It has been found to be common along mountain streams in northern Malaya, and has been taken at an elevation of about 1800 meters. It has also been reported from Borneo.

*Remarks:* The second measured specimen is from Kuala Lumpur, Malaya.

#### FAMILY RHACOPHORIDAE

Until further studies have been made on the arboreal ranid frogs I propose to retain the Rhacophoridae as a family group despite suggestions to the contrary.\*

Four genera are recognized in Thailand. These are *Philautus*, *Theloderma*, *Rhacophorus*, and *Hazelia*. That it is not always easy to assign species to their proper genus is readily admitted. Certain herpetologists have abandoned all or a part of these except the genus *Rhacophorus*.

*Chirixalus* is separated from *Philautus* on the character of the hand. The two inner digits are separated from the other two and tend to be opposite to the two outer digits. In preservation, unless the hand has been spread, this character may not be at all obvious but nevertheless it is real. It is probable that this genus should also be recognized.

Species of *Philautus* often appear to be miniature *Rhacophorus* but in all cases *Philautus* lacks vomerine teeth (a few presumed *Rhacophorus* may lack them also). In the genus *Theloderma*, I am associating frogs having rough warty skins, and an arboreal life history. It includes species that have been assigned to various genera including *Rhacophorus* and *Philautus*.

Each of the above is discussed further under the generic discussions.

#### Genus RHACOPHORUS Kuhl

*Rhacophorus* Kuhl, in Schlegel, Isis, 1827, vol. 20, p. 294, type of the genus? (leucomystax).

This group has in common the habit of depositing the eggs out of water, in trees, shrubs, plants or in the absence of all these on the ground near the water's edge. However, they tend to choose plants that are growing from water or that have branches overhanging water. They may be placed on tree branches as much as thirty feet from the water, or they may be on plants only a few inches above the water surface.

\* See Laurent, Rev. Zool. Bot. Afr., vol. 45, 1, 1951, pp. 116-122. In this paper he proposes to reduce the Rhacophoridae to subfamily rank and elevate certain other African and Madagascar frogs to a family group, Hyperoliidae.

As the eggs are being laid by the female in a place she has chosen, carrying the male with her, the male by movements of his legs churns up the liquid and gelatinous matter extruded with and about the eggs, into a mass of sticky foam. The outer surface of this mass dries and shrinks somewhat forming a crust. It may have the form of a ball with a diameter of from three to four inches. The crust prevents loss of moisture. The young hatch and the foam tends to liquify forming within the mass a small body of water. Eventually this water breaks through the crust of the mass, and falls with the young larvae to the pool of water below.

Often the eggs may be deposited over shallow rain pools which, by the time the young are ready to take up life in water, will have disappeared by draining or evaporation, in which case the young die after falling.

If, however, the water remains the young on reaching it tend immediately to seek the edges of the pool where they may congregate. Here perhaps they find better protection among the plants growing near the edges than in deeper water.

Almost invariably the laying of the eggs begins after the first rains of the season and usually temporary rain pools are chosen rather than streams or larger ponds, presumably because they are more likely to be free of fish. I have, however, found the egg masses along mountain rivulets capable of accommodating small to tiny fish in areas where no temporary rain pools are apparent.

This habit of depositing eggs away from the permanent bodies of water would seem to have considerable survival value, since it occurs in many if not all species of *Philautus*, and *Rhacophorus*, the family Centrolenidae, many genera of the Leptodactylidae, the genus *Agalychnis*, *Phyllomedusa* certain species of *Hyla* and perhaps other genera in the Hylidae. In the case of some Leptodactylidae the transformation of the larvae is direct and without a free swimming period. This is true also of certain species of *Rana*.

#### KEY TO THAI SPECIES OF RHACOPHORUS

1. Fingers strongly webbed (more than half to completely webbed) . . . . . 2  
    Fingers not webbed or with only a trace . . . . . 5
2. A well-defined dermal flap above vent . . . . . 3  
    No dermal flap above vent . . . . . 4
3. A well-defined dermal flap on outside of forearm and on heel; length,  
    to 100 mm. . . . . *nigropalmatus*  
    No dermal flap on outer edge of forearm or at heel; length, to 82 mm.,  
    . . . . . *robinsoni*



4. A dermal flap above vent; black (or blue) spots present behind axilla; tibiotarsal articulation to tympanum; 55 mm. .... *bimaculatus*  
A very prominent dermal flap above vent; no axillary black spots; tibiotarsal articulation to tip of snout or beyond. Green in life, cream in preservative with often fine black dots on back; 68 mm.,  
*dulitensis prominans*
5. Small species; a scalloped fringe on posterior (outer) edge of tarsus and foot; paired vocal sacs present; 30 mm. .... *bisacculus*  
Large species; no scalloped fringe on posterior side of tarsus and foot; a single vocal sac ..... 6
6. Part of skin on head with bony deposit, fused to skull bones; 82 mm.,  
*leucomystax*  
Skin on head not attached to skull; 75 mm. .... *colletti*

### *Rhacophorus nigropalmatus* Boulenger

FIG. 70

*Rhacophorus nigropalmatus* Boulenger, Ann. Mag. Nat. Hist., ser. 6, vol. 16, 1895, p. 170 (type locality, Sarawak); Flower, Proc. Zool. Soc. London, 1899, p. 899; Werner, Zool. Jahrb., Syst., vol. 13, 1900, p. 496, pl. 34, fig. 8; Boulenger, Fasciculi Malayenses., Zool., vol. 1, 1903, p. 137, pl. 6, fig. 1; A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 251, fig. 71; Anderson, Svenska. Ak. Handl. vol. 55, no. 4, p. 17; van Kampen, Amphibia of the Indo-Australian Archipelago, 1923, p. 267.

*Rhacophorus* (R.) *nigropalmatus* Ahl, Das Tierreich, Lief. 55, Anura III, 1931, pp. 166-167.

*Rhacophorus nigropalmatus nigropalmatus* Wolf, Bull. Raffles Mus., no. 12, 1936, p. 200.

**Diagnosis:** A large species reaching a length of 100 mm. snout to vent. Arms, vent, heel, and tibia with dermal folds; fingers entirely webbed; toes entirely webbed; black spots on webs of hands and feet; loreal region oblique.

**Description of species** (from No. 20725 collection of Dr. Boonsong Lekagul, Ban Bang Non, Ranong): Head as broad or broader than body; interorbital distance greater than width of an eyelid; loreal region oblique; canthus rostralis scarcely indicated except immediately behind nostril; loreal region slightly concave; snout sloping obliquely to lip; tympanum large, its diameter (7 mm.), nearly equal to length of eye (7.6 mm.); tympanum separated from eye by a distance equal to about one third diameter of tympanum; choanae moderate; vomerine teeth on ridges arising at anterior inner edge of choanae extending back diagonally, curving slightly, but separated from each other by a gap equal to half length of one series; tongue large, free for more than half its length.

Arms long, two outer fingers fully webbed; between first and second fingers, web fails to reach discs; discs of fingers large, those of two outer fingers larger than tympanum; terminal phalanges of

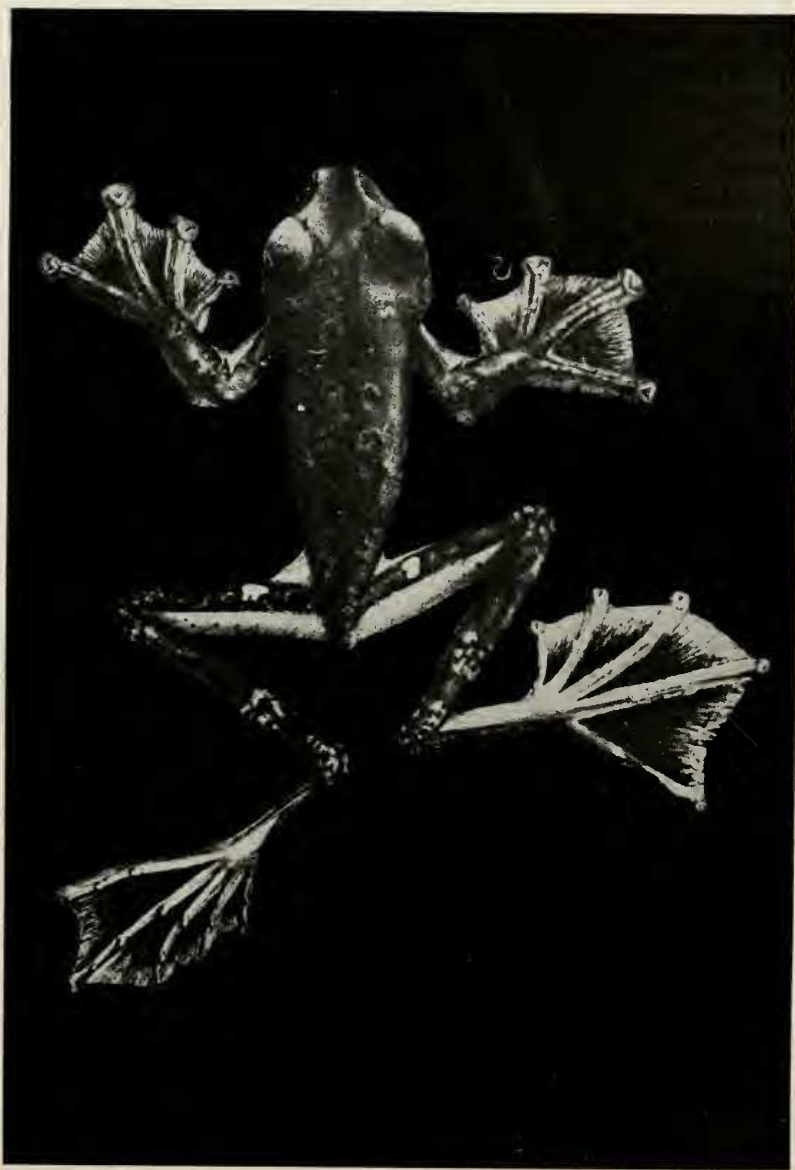


FIG. 70.—*Rhacophorus nigropalmatus* Boulenger. From Boulenger 1903, pl. 6, fig. 1. About natural size.

fingers Y-shaped, branches of Y, forming short ridges on upper surface of discs, each branch two millimeters long; a narrow skin-fold along outer edge of outer finger continued to elbow, widening along radioulna. Outer subarticular tubercles moderate, proximal ones small; metacarpal tubercles, except inner, not well differentiated; numerous small palmar granules.

Leg large, the tibiotarsal articulation reaching little more than halfway between eye and nostril; a projecting normal fold on tibiotarsal joint connecting with a slight fold on outer edge of outer toe. Toes fully webbed, terminating in discs smaller than those on fingers; subarticular tubercles small; some small granules on sole; inner metatarsal tubercle small; no outer tubercle.

Skin nearly smooth along upper part of sides, and on dorsal and lateral surfaces of limbs, but under a lens, minute granulation present. Breast, venter, part of underside and part of posterior face of femur strongly granular or areolate; a strong transverse fold of skin above vent.

*Color:* Above, green in life, the color in preservative (formalin) lively lavender to violet with a few scattered elevated glandular white spots; venter, chin, and underside of limbs whitish; webs on feet somewhat orange with large black areas between toes and between three outer fingers; large ink-black spots behind axillae.

*Measurements in mm.:* Snout to vent, 101; width of head, 33; length of head, 34; arm, 63; width of largest disc, 7.5; leg, 149; tibia, 50; foot and tarsus, 69.

*Variation:* Relatively few specimens of this species have been found. There are, however, certain known variations. The webs on the hand may reach the discs of the first and second finger and the hand is then fully webbed. Boulenger (1912) states that the tympanum is one half to two thirds the diameter of the eye; in the described specimen it is relatively larger; the tibiotarsal articulation may reach the tip of the snout. The color was described by Boulenger (1912): "Color in life green above, powdered with white or with lichen-like white markings; one or two conspicuous white spots on the upper surface of the thigh; flanks yellow or orange, veined with black; interdigital membranes black at the base, yellow or orange veined with black towards the border; throat and chest cream-colour, belly and lower surface of limbs salmon-pink, sometimes dotted over with yellow."

*Distribution:* In Thailand the species is known from "Mabek,

Jalor, Pattani"; Ban Bang Non, Ranong; and "extreme north of Siam."

The species was originally described from Sarawak. Since then it has been taken in Sumatra and Malaya.

*Remarks:* Boulenger 1903 suggests that this species may be the "flying frog" reported by Wallace from Borneo. Gadow (1909), however, believes the species to have been *Rhacophorus pardalis*, a much smaller frog, and identifies Wallace's specimens with that species, the largest of which has a length of about 65 mm. He computes the total surface of hands and feet to be 18.8 square centimeters instead of 78 square centimeters as was erroneously reported by Wallace.

*Rhacophorus robinsoni* Boulenger

FIG. 71

*Rhacophorus robinsoni* Boulenger, Fasciculi Malayenses, Zoology, vol. 1, 1903, p. 136, pl. 5, fig. 2 (type locality, Bukit Besar, 2500 ft., Pattani, Thailand); Journ. Federated Malay States Mus., 1908, vol. 3, p. 63; A vertebrate fauna of the Malay Peninsula. . . . Reptilia and Batrachia, 1912, pp. 249-250.

*Rhacophorus R. robinsoni* Nieden, Das Tierreich, Lief. 55, Anura III, Mar. 1931, p. 157.

*Rhacophorus pardalis robinsoni* Wolf, Bull. Raffles Mus., no. 12, 1936, p. 208.

*Diagnosis:* Fingers nearly entirely webbed, discs as large as tympanum; toes fully webbed; skin smooth above; no dermal flaps on heel or above vent; vomerine teeth on elongate ridges beginning close to anterior edge of choanae.

*Description of species* (from B. M. No. 1906.2.28.7, Kuala Teku, Pahang, Malaya, 500 ft., adult female): Snout obtusely pointed, a little longer than orbit; nostril about equidistant between eye and tip of snout, very slightly nearer latter; canthus rostralis distinct; loreal region nearly vertical, somewhat concave; top of head rather concave; strong fold from eye continuing back, covering upper edge of tympanum and extending to point above and behind level of arm-insertion; tympanum large, its diameter (5.3 mm.) little more than half length of eye (10 mm.), separated from eye by distance less than one fourth its diameter.

Vomerine teeth on two elongate slightly curving ridges, arising from anterior inner edge of choanae, separated mesially by a distance about two fifths of length of one ridge; palatal glands opening in a transverse sinuous, more or less continuous groove on palate close to anterior level of choanae; tongue free behind for more than two fifths of its length.

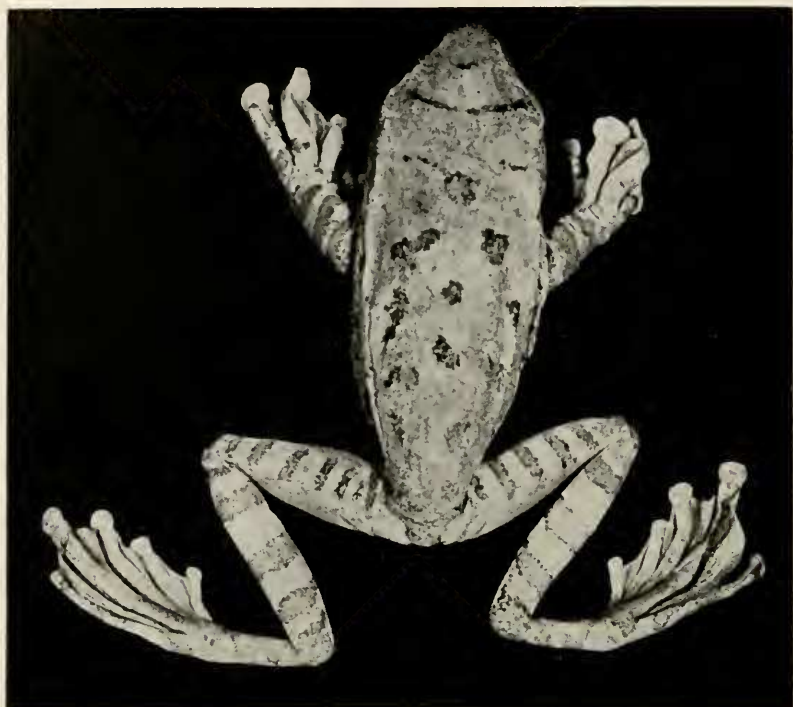


FIG. 71.—*Rhacophorus robinsoni* Boulenger. B. M. No. 1906.2.28.47. Actual snout-vent length, 59 mm. Kuala Teku, Pahang, Malaya.

Arm well developed without fringe, fingers with widened terminal discs, width of three outer ones equal to diameter of tympanum; on three outer fingers webs extend to base of discs, but only halfway to disc on first finger; subarticular tubercles small; inner metacarpal tubercle large projecting; legs moderate, tibiotarsal articulation reaching forward to beyond eye; legs folded at right angles to body, heels overlap four millimeters; toes with widened discs smaller than those on fingers, completely webbed, the webs attaching to sides of discs; a very small inner metatarsal tubercle, no outer; no tarsal fold; prominent skin-fold along edge of outer finger, a smaller one on outer toe; subarticular tubercles under toes small; very small supernumerary tubercles on soles and palms.

Skin above smooth; skin on head free; above arm and less distinctly on sides, skin finely grooved or wrinkled; chin and breast smooth, venter strongly granular; skin on exposed part of arm and leg smooth; inner posterior part of ventral surface of thigh and an area on posterior surface below vent with fine granules.



*Color:* In preservative, pinkish to rusty brown with narrow dark bar crossing head in supraorbital region; scattered spots of black on dorsum, some with brown centers; arm banded with black; five short bands on thigh and tibia, three median much wider than corresponding bands on thigh; entire posterior side of thigh dark gray with some darker mottling; webs dark to black; side of head dark lavender with some lighter flecks; cream spot close below eye (left side), and small white spot on lip below eye (right side); chin and breast cream with scattered brownish flecks; venter strongly spotted or reticulated with brown; brown spotted on underside of thighs and tibia.

*Measurements in mm.:* Snout to vent, 59; width of head, 29; length of head, 24; arm, 49; leg, 123; tibia, 38; foot and tarsus, 57.

*Variation:* This is, I believe, the second specimen known. It is larger but differs but little from type save in some details of coloration and marking. Boulenger (1912) states: "Pinkish brown or pale coffee colour above, bluish gray on sides of body and limbs; sides of head darker, purplish gray to blackish, which shade is sharply defined on the canthus rostralis; more or less defined dark spots on the back; limbs with grayish brown crossbars; interdigital webs blackish with light veins; whitish beneath, throat spotted or mottled, belly marbled with gray.

"The type measured 82 mm. from snout to vent."

*Distribution:* The type came from Bukit Besar, a mountain in the present provinces of Pattani, Songkhla and Yala. It is most probable that the exact type locality is in the province of Pattani.

Outside of Thailand a specimen has been taken at Kuala Teku, Pahang, at 500 feet. This specimen forms the basis of this description.

*Remarks:* It would appear that *Rhacophorus robinsoni* differs so markedly from *Rhacophorus pardalis* that I cannot accept Wolf's suggestion of placing it as a subspecies of the latter.

### *Rhacophorus bimaculatus* Boulenger

FIG. 72

*Rhacophorus reinwardtii* Jerdon, Proc. Asiat. Soc. Bengal, 1870, p. 84 (not of Kuhl).

*Rhacophorus maculatus* Anderson, *ibid.*, 1871, p. 27 (not of Gray).

*Rhacophorus bimaculatus* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd Ed., 1882, pp. 90-91 (type locality Khasia and Assam); The fauna of British India . . . Reptilia and Batrachia, 1890, p. 472; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 202; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 250; Annandale, Rec. Ind. Mus.

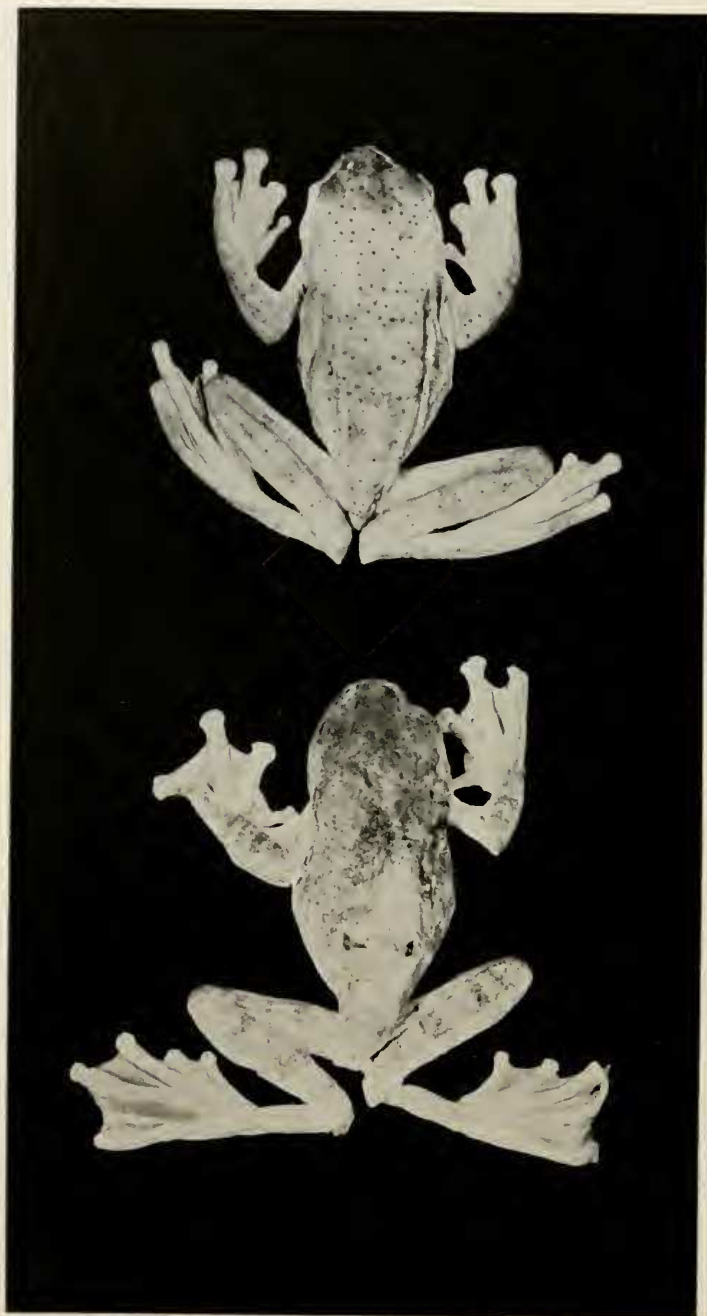


FIG. 72.—*Rhacophorus bimaculatus* Boulenger. Upper figure, No. 36012 ♀. Actual snout-vent length, 47 mm. Doi Suthep, Chiang Mai, Thailand. Lower figure, No. 36279 ♀. Length, 46.5 mm., Kaeng Pang Tao, Chiang Mai, Thailand.

- vol. 8, p. 12; M. Smith, Journ. Federated Malay States Mus., vol. 10, 278; Bull. Raffles Mus., no. 3, Apr. 1930, p. 114 (Nakhon Si Thammarat Mts.).
- R[hacophorus] (R.) bipunctatus* Ahl, Das Tierreich, Lief. 55, Anura III, Mar. 1931, pp. 168-169; Sitzb. Ges. Fr. Berlin, 1927, p. 46.
- Rh[hacophorus] reinwardti bipunctatus* Wolf, Bull. Raffles Mus., no. 12, 1936, p. 214; Bourret, Les Batraciens de l'Indochine, 1942, p. 446.

*Diagnosis:* Digits of hand with broad terminal discs, outer as large or larger than tympanum; outer fingers four-fifths webbed; toes webbed to discs except on fourth; strong fringe along outer finger and forearm; fringe along outer toe to tarsus forming one or two free flaps on tibiotarsal joint; a preanal flap; males with vocal sac; pair of axillary spots, rarely two spots on each side. Green or gray above, rarely red-brown with black dots; pure white or yellowish on venter.

*Description of species* (from No. 33730 ♀ Doi Suthep near Chiang Mai, Chiang Mai province): Head rather broad, interorbital space equal or slightly exceeding width of an eyelid; top of head flat, but from nostrils snout slopes down to terminal point on upper lip; nostril closer to eye than to tip of snout; canthus rostralis rounded, scarcely indicated; tympanum distinct, its diameter (3.4 mm.); shorter than length of eye (5.2 mm.); eye to tip of snout nine mm. Vomerine teeth on two transverse ridges that begin on inner edge of choanae; separated mesially by a distance equal to length of single ridge; palatal glands open in median groove closer to anterior level of choanae than to front of palate. Tongue large, strongly bifid posteriorly, free for more than half its length posteriorly, and free on sides. (Males with vocal sac and elongate vocal slits). Arm rather short, permanently (?) flexed at elbow with small prebrachial web; fingers with broad terminal discs, outer ones equal to size of tympanum, inner one small; three outer fingers about four-fifths webbed; subarticular tubercles small, distinct; toes webbed to discs on outer toes, while on inner side of first three, web scarcely reaches discs; a small indistinct inner metatarsal tubercle; a fringe on outer finger which reaches elbow (widening somewhat); fringe on outer toe reaches tarsus forming there a free flap; tibiotarsal articulation reaches to tympanum.

Skin above minutely corrugated (under lens); skin of chin and breast minutely wrinkled; entire venter, lower sides, and most of undersurface of thighs regularly granular or areolate. A few granulations on posterior face of thigh behind vent; well-defined sinuous transverse flap above vent.

*Color in life:* Generally lavender brown above; back very indefinitely marked, with dark line between eyes; faint X-shaped

mark on shoulder discernible when submerged in clear liquid; webs of hand and foot orange. Sides and all undersurfaces white with a slight ivory cast; black spot on side in axillary region.

Measurements in mm. of *Rhacophorus bimaculatus*

Number.....	33730	67	68	69	70
Sex.....	♀	♂	♂	♂	♂
Snout to vent.....	54	35.2	36	37	36.5
Snout to eye.....	9	6	6.1	5.8	5.6
Length of eye.....	6.2	5.3	5	4.8	5
Diameter of tympanum...	3.5	2.6	2.5	2.35	2.3
Axilla to groin.....	31	21	18	19	19
Width of head.....	20	13.5	12.9	13	14
Length of head.....	16.5	13	12.2	12.2	13.2
Arm.....	33	23	22	23	23.8
Leg.....	73	54	55.6	57	57
Tibia.....	23.5	17	18	19	18.6
Foot and tarsus.....	31	22	22	24	24

*Variation:* A series of males from Northern Chiang Mai province shows some variation in the markings.

No. 68 is dark lavender above, and pure white below. Darker markings on the dorsum (dark bar across eye, indefinite X-shaped markings on shoulders and the transverse marks on back and on limbs) are scarcely discernible unless submerged in clear liquid. An axillary black mark present, followed by one or two others. An orange web on foot and between two outer fingers.

No. 67. This is dark maroon to magenta above, the dark markings indistinct; a black axillary mark, followed on each side by three rounded white spots, more or less outlined in black, extends to the groin. Some black flecks are present on chin.

No. 69. The dark dorsal marks are distinct and the X-shaped mark is widened to form a large blotch. Only a narrow stripe of color is present above the white thigh. The darker bars on arms and limbs are distinct.

No. 70. The dorsal markings are distinct and there is a single axillary spot.

In the described specimen there is only a narrow line of pigment along the upper surface of upper arm and along the upper part of the femur. The specimen described (No. 33730) has become nearly uniform dark lavender on the dorsal surface.

A very brilliantly-colored specimen from Fraser's Hill, Malaya, in preservative one month, is coffee-brown above with minute fleck-

ings and reticulations of black; the bars on the limbs are moderately distinct. Chin, sides, venter, and underside of limbs, formerly bright chrome-yellow, are now pure white. The sides are white with a large axillary blue spot followed by an equally large lateral spot and paired spots on sides of venter with two small ones on each side of the anal area. All the blue spots are speckled with very numerous minute white dots. When first captured, the specimen was very light clay color above. Within an hour it was grass green, later turning coffee-brown. With its orange and yellow hands, red-orange feet, it was one of the most brilliantly-colored amphibians I have seen.

*Distribution:* The species has been taken in Nakhon Si Thammarat, and in the province of Chiang Mai at elevations of about 800 ft.

It has been taken in Malaya (Fraser's Hill, and Larut, Perak). It is known also in Assam and Burma.

*Remarks:* A female, found about midday at Paeng Kang Tao in bushes near a swampy area, was attached to a leaf and appeared to be in a deep sleep.

*Rhacophorus dulitensis prominanus* M. Smith

FIG. 73

*Rhacophorus prominanus* M. Smith, Journ. Federated Malay States Mus., vol. 9, pts. 3 and 4, March, 1924, pp. 185-186, figs. A and B (type locality, Jor, Batang Padang, Perak, altitude 600 meters); Bull. Raffles Mus., no. 3, Apr. 1930, pp. 114-115 (Banang Star, Patani = Bendang Stah, Yala).\*

*R[hacophorus]* (R.) *prominanus* Ahl, Das Tierreich, Lief. 55, Mar. 1931, p. 165. *Rhacophorus dulitensis* (part.) Wolf, Bull. Raffles Mus., no. 12, 1936, pp. 210-211.

*Diagnosis:* A medium-sized species of the genus (snout to vent, 68 mm.); head except in young, broader than long, depressed; diameter of tympanum five sixths of eye length; vomerine teeth present; interorbital width greater than width of an eyelid; fingers broadly webbed; toes fully webbed, discs of all digits much widened, the largest equal to tympanum; tibiotarsal articulation to tip of snout; strong skin-fold along outer side of arm and hand and along foot, terminating at heel; anal region with very prominent cutaneous flap, the vent in middle of its undersurface. Green in life with numerous small brown spots; yellowish white below.

*Description of species* (from EHT-HMS No. M. 149 ♀, Kuala Tahan, King George V, National Park, Pahang): Head depressed, its width (15.2 mm.) slightly greater than length (14 mm.); canthus

\* Sometimes spelled Banang Stah or Benang Star.



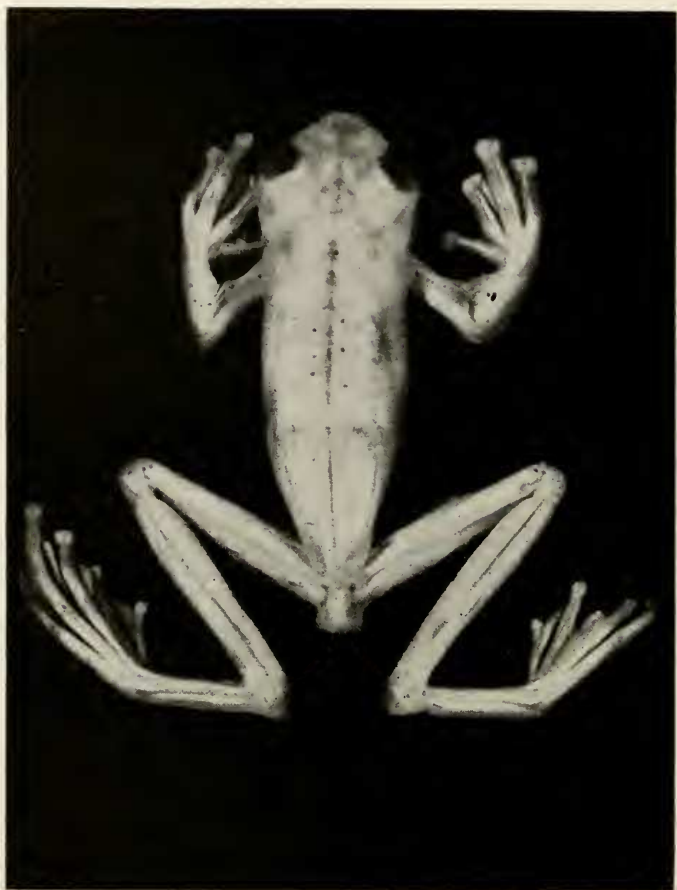


FIG. 73.—*Rhacophorus dulitensis prominanus* (M. Smith)  
EHT-HMS No. M. 149 ♀. Actual snout-vent length, 42 mm.  
Kuala Tahan, Pahang, Malaya.

rostralis angular, loreal region slightly oblique not or scarcely concave; snout rather pointed, projecting somewhat beyond mouth; nostril nearer tip of snout than to eye; tympanum distinct, its diameter less than eye length, very narrowly separated from eye; width of eyelid in interorbital width about one and one-fourth times; tongue large, notched behind, free for about two fifths of its length; vomerine teeth on two elevated ridges set in from choanae, not extending to their posterior level, and separated from each other by distance much greater than length of one elevation.

Arm short, digits broad, flattened, tips widened into discs, outer

oues as wide as diameter of tympanum; outer fingers fully webbed, inner fingers, half webbed; large inner metacarpal tubercle, median and outer small; subarticular tubercles distinct, single; palm with numerous granules; fringe on outer side of hand continuing to elbow; very slight but distinct axillary web; small web in front of arm opposite elbow. Legs moderately long, tibiotarsal articulation reaches tip of snout; toes completely webbed; very small inner metatarsal tubercle; no outer; subarticular tubercles moderate; metatarsals completely separated by web. A fringe along outer toe continued along tarsus to end of heel; distinct flap slightly notched in middle projects above anus, the vent opening in middle of underside of flap.

Skin, seen under a lens, finely corrugated above; sides nearly smooth; chin and breast with minute granules; breast and venter with flat granules or areolae; underside of thigh with similar granules intermixed with an irregular transverse row of larger elevated granules or tubercles; posterior face of thigh smooth (under a lens minutely wrinkled).

*Color:* In life bright green with some fine brown spots; in preservative very light yellow brown (nearly cream) with a few brown dots above; canthus and tip of snout brownish; black spot on eyelid; entire ventral surface of body and limbs yellowish or cream, with trace of an orange spot on outer web membranes of foot.

*Measurements in mm.* (Nos. 148 and 149, respectively): Snout to vent (end of flap), 50.5, 42; width of head, 15.2, 12.6; length of head, 14, 13.5; arm, 30.6, 25; leg, 74, 59; tibia, 26.5, 21; foot and tarsus, 34.2, 27.5.

*Distribution:* In Thailand this form has been found only at "Benang Star" in Yala, a relatively short distance from the Malayan border. In Malaya it has been taken in Perak (the type series); and in Pahang (King George V National Park).

*Remarks:* The anal flap occurs also in *Rhacophorus bimaculatus* but is rarely so well-developed as in *prominans*. This flap is greatly reduced in *dulitensis dulitensis*.

M. Smith records the living colors: "deep green in life with numerous small dark brown spots; below yellowish white, uniform. Supraorbital region and anal projection ochreous yellow, web of fingers greenish yellow, web of toes yellow at the base, carmine at the margin."

*Rhacophorus bisacculus* sp. nov.

FIG. 74

*Type*: No. 34960. Collected March 14, 1958, Phu Kading, Loei province, at an elevation of 3800 ft., by Edward H. Taylor.

*Paratype*: No. 34959. Topotype. Same date and collector.

*Diagnosis*: Vomerine teeth weak, in two transverse rows between choanae, widely separated mesially; snout pointed at tip; all fingers with web remnants; chin, venter, and underside of femora granulate; paired lateral vocal sacs at mouth angles; toes at least three-fourths webbed; a row of tubercles on underside of arm, and a similar row on tarsus, continuing onto outer digits. Vocal sacs present.

*Description of type*: Snout triangular in outline, terminating in a small "nose" extending beyond lower jaw, then sloping backwards and downwards to lip; canthus rostralis not or scarcely indicated; loreal region sloping obliquely, shallowly concave; area about nostrils swollen, elevated somewhat, distance between nostrils slightly greater than interorbital distance which is narrower than width of an upper eyelid; tympanum large, well defined, its diameter (2 mm.) a little less than half length of eye (4.6 mm.); snout practically as long as eye.

Tongue strongly notched behind, free for little more than a third

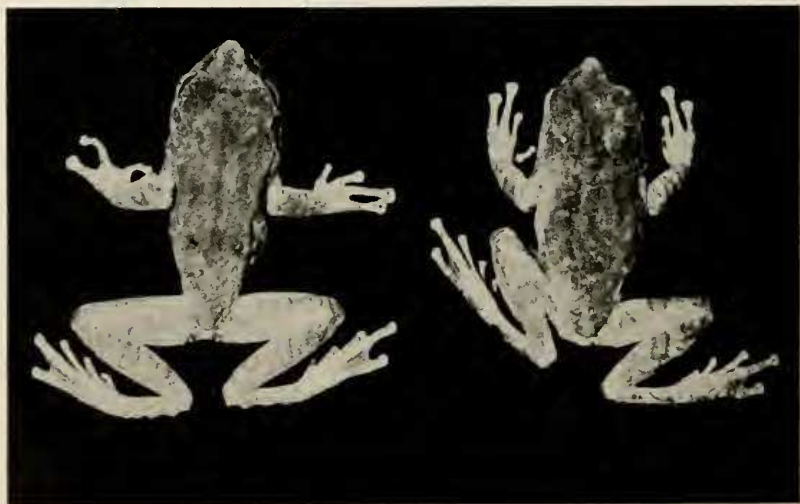


FIG. 74.—*Rhacophorus bisacculus* sp. nov. Left figure, No. 34960 ♂. Type. Actual snout-vent length, 30 mm. Right figure, paratype, No. 34959 ♀. Length, 29 mm. Both, Phu Kading, Loei, Thailand.

of its length; vomerine teeth on two low ridges arising near inner edges of choanae, running transversely and somewhat diagonally, separated mesially by distance greater than length of one series.

Male with vocal sacs, situated near angle of mouth, opening into mouth through two small puckered openings just back of level of mouth-angle.

Arm moderate; first finger very small, with basal swelling and large nuptial patch covered with asperities; metacarpal tubercles distinct, largest at base of first finger; distinct remnant of web between fingers, continuing on sides of fingers as fine ridges; distal subarticular tubercles distinct, large, proximal ones much smaller; tips of digits dilated into discs, each with peripheral groove, outer ones more than twice width of inner; somewhat broken fleshy fold on outer edge of fourth finger, continued on forearm to elbow as a linear series of tubercles. Leg moderately long, tibiotarsal articulation reaching to a point near halfway between eye and nostril; legs folded at right angles to body heels overlap two millimeters. Toes about three-fourths webbed except first and second which are less than half webbed; discs of toes smaller than those on fingers; subarticular tubercles distinct, distal ones larger than proximal ones; some granules on sole; an inner metatarsal tubercle, no outer; a broken fringe on outer toe continued along tarsus with a series of conspicuous tubercles. Skin with some scattered flat tubercles on head, eyelids, and occiput; fewer tubercles on dorsum, numerous, and a little larger on sides, finely granular on rump. Some prominent tubercles on end of tibia; chin finely granular, breast nearly smooth; venter and lower part of sides strongly and uniformly granular. Most of underside of femur and anal region granular. Strong fold from eye above tympanum to above arm-insertion.

*Color:* Dorsum dark brown with a darker somewhat triangular area on occiput; a pair of dark lines from eye curving back and becoming lost on sides; darker band between eyes and some indefinite marks on sides of head and on lips; tympanum brownish; narrow pigmented stripe along dorsal part of femur showing darker banding; front and back of femur light with thinly scattered nearly uniform pigment; chin clouded blackish; throat, breast, venter, and undersides of limbs whitish or yellowish-white; underside of feet dark. Region about vent blackish preceded by an irregular pair of lavender spots.

*Measurements in mm.* (type ♂ and paratype ♀, respectively): Snout to vent, 30, 29; width of head, 12, 11.6; length of head, 11.4,

10; arm, 19, 19.2; leg, 44.4, 44; tibia, 15, 15; foot and tarsus, 19, 19.6.

*Variation:* The tubercles on tarsus are more conspicuous in the type (see figure) than in the paratype. The pattern on the paratype is less distinct than that of the type.

*Distribution:* Known only from the type locality.

*Remarks:* I believe this species is related to *Rhacophorus appendiculatus*, and *chasei*. I do not, however, regard it as a subspecies of either of those forms. *R. chasei* has been reported in Malaya. This is approximately 800 miles south of the Thai locality from which *bisacculus* is known.

The two specimens were taken at night from plants growing in the edge of a tiny rivulet on the side of Phu (mountain) Kading. The latter is something more than 5000 ft. in elevation. The top is relatively flat, with several slow-flowing streams and covered by a splendid coniferous forest.

*Rhacophorus leucomystax leucomystax* (Kuhl, in Gravenhorst)

FIGS. 75, 76

*Hyla leucomystax* Kuhl, in Gravenhorst, *Deliciae Musei Zoologici Vratislaviensis*, . . . fasc. 1, 1829, p. 26 (type locality, Java).

*Polypedates leucomystax* Cantor, *Journ. Asiat. Soc. Bengal*, vol. 16, 1847, p. 1063.

*Polypedates maculatus* (part.) Günther, *The Reptiles of British India*, 1864, p. 428.

*Polypedates rugosus* Duméril and Bibron, *Erpétologie générale* . . . vol. 8, 1841, p. 520 (part.).

*Rhacophorus maculatus* (part.) Boulenger, *Catalogue of the Batrachia Salientia s. Ecaudata*, in the British Museum, 1882, p. 83.

*Rhacophorus leucomystax* Boulenger, *The fauna of British India* . . . Reptilia and Batrachia, 1890, p. 474; Flower, *Proc. Zool. Soc. London*, 1896, p. 905, pl. 44, fig. 2; *ibid.*, 1899, p. 898, pl. 59, fig. 3; Laidlaw, *Proc. Zool. Soc. London*, 1900, p. 887; Butler, *Journ. Nat. Hist. Soc. Bombay*, vol. 5, 1903, p. 202; Boulenger, *A vertebrate fauna of the Malay Peninsula* . . . Reptilia and Batrachia, 1912, pp. 248-249; van Kampen, *Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien*, Bd. 4, 1907, pp. 399, 411; M. Smith, *Journ. Nat. Hist. Soc. Siam*, vol. 1, no. 3, Mar. 1915, p. 156 (Sai Yoke, Kanchanaburi province); *ibid.*, vol. 2, no. 2, Dec. 1916, p. 168; *ibid.*, p. 229; *ibid.*, p. 267 (tadpoles); *Journ. Nat. Hist. Soc. Siam*, vol. VI, no. 2, Oct. 1923, p. 211 (Hainan).

*Rhacophorus leucomystax leucomystax* Wolf, *Bull. Raffles Mus.*, no. 12, 1936, pp. 178-181; Bourret, (part.) *Les Batraciens de l'Indochine*, 1942, pp. 426-430 (large synonymy and literature list, up to 1942).

*R[hacophorus]* *R. leucomystax* Ahl, *Das Tierreich*, Anura III, Lief. 55, 1937, pp. 134 (part.). (Not fig. 83.)

*Diagnosis:* A large species (75 mm.) characterized by having much of the skin on head involved with nasal and frontoparietal bones; vocal sac present in male; interorbital space wider than upper eyelid; tympanum distinct; fingers with very small web. Toes





FIG. 75.—*Rhacophorus leucomystax leucomystax* Kuhl in Gravenhorst. KU No. 40194. Actual snout-vent length, 60 mm. Khon Kaen, Thailand.

two-thirds or more webbed; digital discs smaller than tympanum; tibiotarsal articulation to between eye and nostril or to tip of snout; well-developed vomerine teeth; hourglass-shaped figure on head and occiput reaching shoulders.

*Description of species* (from No. 1140, Siracha, Chon Buri): Head subtriangular, its width (26.5 mm.) slightly wider than long (25 mm.); canthus rostralis distinct, rounded, loreal region oblique, slightly concave; at level of nostrils snout turns down and ends in point slightly in advance of mouth; snout longer than eye; tympanum large, its diameter about seven eighths of length of eye.

Vomerine teeth on two elevated ridges, continuous with a slight ridge along upper border of choanae, slightly diagonal but not reaching back level of choanae, separated mesially by a narrow space; choanae moderately large; tongue free for two fifths of its length. (Male with vocal sac; vocal slits small, near angle of jaws).

Fingers moderate, first shorter than second; terminal discs widened, two outer largest but these little more than half area of tympanum; subarticular tubercles single, well developed; inner metacarpal tubercle flat; a beadlike median, and a small outer metacarpal tubercle; supernumerary tubercles on palm. Leg moderate tibiotarsal articulation reaching nostril; when heels are folded at right angles they overlap three millimeters. Foot two-thirds webbed, terminal discs smaller than those on outer fingers; subarticular tubercles well developed; small inner metatarsal tubercle and smaller outer; dim granulation on sole. Skin above generally smooth, but under a lens appearing finely granulated; skin covering nasal bones and that on frontoparietals with a bony surface; a small triangular bony area above tympanum; a fold from eye runs above tympanum and reaches point above arm; chin vaguely granular on sides; breast smooth; venter and much of ventral and posterior surface of thighs with small granules.

*Color:* Head light amber-brown; body generally fawn with gray markings and clouding. An indistinct dark band below canthus rostralis; a dim band between eyes; an hourglass-shaped mark on back of head and neck, extending on shoulders; some irregularly placed darker marks on back and rump; limbs with dim darker bands; back of thigh enclosing numerous rounded gray-white dots; web of foot dusky. Back of thigh brown with cream-white spots.

*Measurements in mm.:* Snout to vent, 75.5; width of head, 26.5; length of head, 25; arm, 45.5; leg, 114; tibia, 40; foot and tarsus, 49.

*Variation:* There is remarkable variation in color in the living



FIG. 76.—*Rhacophorus leucomystax leucomystax* Kuhl, in Gravenhorst. No. 1140. Actual snout-vent length, 66 mm. Chalermklaub Royal Forest, Siracha, Chon Buri, Thailand.

animal since it is able to change its color in a short time. Green is rather unusual, but brown, gray, fawn and yellow are common.

The size of the tympanum varies, some populations having tympani a fourth to a third smaller than the one described here.

Eggs are laid in masses of foam that is churned up by the male as the eggs are deposited. These may be placed in shrubs several feet above water or they may be placed in trees on branches more than twenty feet above water. If no trees or shrubs are available the eggs may be placed at the edge of a pool or directly in the water on floating trash. The species usually chooses to lay eggs in temporary pools that have no fish.

A breeding population was found at Chalermklaub in the Royal Forest east of Siracha. Most of the individuals captured were heavily covered with fine pustules studded with small pearly spinules. This was evident on both males and females.

*Distribution:* This form occurs throughout Thailand in suitable places and it could doubtless be found in every province. Outside of Thailand the species occurs throughout southeast Asia and the Malay Peninsula and also in certain islands of the Indo-Australian Archipelago. However, in most of the latter areas a four- or six-lined form occurs.

*Rhacophorus leucomystax sexvirgatus* (Reinwardt, in Gravenhorst)

FIG. 77

*Hyla sexvirgata* Reinwardt in Gravenhorst, *Deliciae Musei Zoologici Vrat-slaviensis* . . . fasc. 1, 1829, p. 26 (type locality, Java).

*Hyla quadrilineata* Nova Acta Acad. Caes. Leop-Carol. Nat. Cur., vol. 17, 1835, p. 260, pl. 20. fig. 1 (type locality, Manila, restricted).

*Polypedates quadrilineatus* Günther, Catalogue of the Batrachia Salientia in the collection of the British Museum, 1858 (1859), p. 79; The Reptiles of British India, 1864, p. 429; Steindachner, Reise der Österreichischen Fregatta Novara . . . Zoologischen Theil, Amphibien, 1867, p. 49; Anderson, Proc. Zool. Soc. London, 1871, p. 207; Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd Ed., 1882, pp. 84-85 (Singapore, Java, Philippines, Formosa, and Indo-Australian Archipelago).

*Rh[acophorus] leucomystax leucomystax* Wolf, Bull. Raffles Mus., no. 12, 1936, pp. 178-180 (part.).

*Diagnosis:* This subspecies occurring in southern Thailand differs from the preceding chiefly in having four dorsal dark stripes, and a longer or shorter stripe from tympanum along side.

*Description of species:* In this form there is usually a dark mark near tympanum followed by a few dark spots as in *leucomystax*, or the spots may become a stripe that extends for a longer or shorter distance along sides. This is present in the "*quadrilineatus*" form to a greater or lesser degree and in *sexvirgatus* it is usually present as a continuous stripe to groin. (*vide* Van Kampen.) The disposition of the four dorsal stripes is much the same in both nominal forms.

The material I have examined largely from southern Thailand, suggests that the four- and six-lined forms differ only in the distinctness of the lateral stripe. If one regards them as the same form then the earlier name *sexvirgatus* Reinwardt in Gravenhorst will take precedence over *quadrilineatus*.

*Distribution:* I have found the lined form only in southern Thailand in the province of Yala. This may be an area of intergradation since typical *leucomystax* were taken at the same locality.

*Remarks:* I do not distinguish differences in behavior between



FIG. 77.—*Rhacophorus leucomystax sexvirgatus* Reinwardt in Gravenhorst. Fig. from van Kampen (1923), p. 249, fig. 27.

*Rhacophorus l. leucomystax* and *l. sexvirgatus*. It is difficult to say whether the latter should have the status of a subspecies or a color variety. I am treating it as the former.

*Rhacophorus colletti* Boulenger

FIG. 78

*Rhacophorus colletti* Boulenger, Proc. Zool. Soc. London, 1890, p. 36 (type locality, Langkat, Sumatra); Werner, Zool. Jahrb., Syst. vol. 13, p. 494, pl. 32, fig. 4; van Kampen, Amphibia of the Indo-Australian Archipelago, 1923, p. 250; M. Smith, Proc. Zool. Soc. London, 1924, p. 225 (Pattani); Bull. Raffles Mus., no. 3, Apr. 1930, pp. 112-113 ("Bangnara Patani" = Narathiwat Narathiwat).

*R[hacophorus] (R.) colletti* Ahl, Das Tierreich, Lief. 55, Anura III, 1931, p. 121.





FIG. 78.—*Rhacophorus colletti* Boulenger. No. 1311 ♀. Actual snout-vent length, 75 mm. La Doo Tin Mine, Benang Stah, Yala, Thailand.

*Rhacophorus leucomystax leucomystax* (part.) Wolf, Bull. Raffles Mus., no. 12, 1936, pp. 178-179.

*Diagnosis:* A large species (75 mm.); vomerine teeth between large choanae; canthus rostralis angular; interorbital space broader than eyelid; eyes large, tympanum distinct, finger discs large but smaller than tympanum; tibiotarsal articulation to beyond tip of snout; skin of head free, not involved with skull bones; anal region blackish with a light edge above. Web rudiment on hand. Toes webbed.

*Description of species* (from No. 1311 La Doo Tin Mine near Malay border of Kedah just northwest of Bukit Bubus): Head sub-triangular, eyes strongly elevated; canthus rostralis bluntly angular, loreal region oblique, concave; in front of nostrils snout turns down to mouth; snout longer than eye, rounded at tip; head (in large female) a little broader (27.7 mm.) than long (25 mm.); eyelid equal or slightly less than interorbital width; nostril much nearer tip of snout than to eye; tympanum large, its vertical diameter (5.5 mm.) less than length of eye (8.2 mm.), separated from eye by very narrow distance. Straight fold from eye runs across upper edge of tympanum and straight back terminating on shoulder; skin of head not fused with skull bones.

Vomerine teeth on two elevated diagonal ridges arising on anterior inner edge of choanae and extending beyond their posterior level, separated from each other by a distance equal to more than half length of one ridge; tongue large, free for two fifths of its length; (male with two small puckered vocal slits opening into vocal sac back near level of mouth-angle; the choanal openings larger, and the vomerine ridges smaller and farther apart).

Arms large, fingers long, digital discs with as great a diameter as tympanum but with smaller area; first finger equal or slightly shorter than second; vague web-rudiments continued as ridges along sides of fingers; discs wider than long; subarticular tubercles large, single; a strong elongate somewhat compressed inner metacarpal tubercle; an elongate median tubercle and a small outer; several supernumerary tubercles on palm; an indistinct row of small tubercles on under posterior part of arm. Leg elongate, toes about four-fifths webbed; discs subequal, smaller than those on fingers; a flat inner metatarsal tubercle, a small outer; subarticular tubercles well developed; small tubercles on sole indicated; tibiotarsal articulation to five millimeters beyond snout; when heels are folded at right angles to body, the heels overlap about six millimeters.

Skin generally smooth but under a lens finely granular, the granules equal, close set; very small indistinct granules or areolae under chin; breast smooth; venter, most of underside and part of posterior part of thigh, as well as lower sides, with granules or areolae; a few enlarged white tubercles bordering anal region.

*Color:* Above mottled grayish brown; sides of body somewhat lighter, with a few scattered small black spots in lumbar region; a V-shaped mark terminating on inner side of eyelids; arms and legs dimly barred; anal region dark, more or less edged with white; two small but conspicuous tubercles on upper edge of a small anal flap.

Measurements in mm. of *Rhacophorus colletti*

Number.....	1311	1300	1301	1302
Sex.....	♀	♂	♂	♂
Snout to vent.....	75	51	51	53
Width of head.....	27.7	17.2	17.4	18
Length of head.....	25	17.6	19	18
Length of snout.....	10.2	7.6	7.8	8
Length of eye.....	8.2	6.8	7	7.3
Arm.....	53	35	33.3	34
Leg.....	130	89	83	91.5
Tibia.....	44	30.6	28	30
Foot and tarsus.....	56	37	35.5	38.1

(All from same locality. No. 1302 was clasping a female.)

*Variation:* There is some variation in dorsal markings. The V-shaped mark is more or less evident in all specimens. Some show black flecks or spots that are absent in others. Two have a dim bar across the eyelids. The lip is not white. The skin on top of head is loose in all.

The males have rather more pointed snouts than the female and the head width and length is equal or perhaps slightly longer than wide. The tibiotarsal articulation reaches beyond the tip of the snout in all, some not so far as in the female. The eyelid equals the interorbital width in two specimens. The female has a peppering of pigment on chin and throat. The web on the foot is blackish. Males may have two slight elevations in the interorbital area.

*Distribution:* In Thailand, specimens have been taken in Narathiwat and Yala. So far as I know none has been taken in Malaya. Otherwise known in the Indo-Australian Archipelago.

*Remarks:* This species has been mistaken for *leucomystax*, and Wolf (1936) has erroneously placed it in the synonymy of that species.

The two are definitely distinct since in *leucomystax*, ossification of the dorsal head skin is not a variable character. The two species are found together in southern Thailand and presumably throughout the remainder of the range of *colletti*. Neither Malcolm Smith (1930) nor Boulenger (1912) report the species in Malaya. It must occur there since my specimens were taken close to the Malayan border.

The female clasped by one of the males was beginning to deposit eggs when taken. The eggs were in a mass of foam. *R. leucomystax* was present in a nearby pool, and seemingly much more numerous than *colletti*.

### Genus HAZELIA Taylor

*Hazelia* Taylor, Philippine Journ. Sci., vol. 16, 1920, p. 292 (type of genus *H. spinosa* Taylor).

*Diagnosis:* No vomerine teeth; tongue bifurcate (or notched) behind; pupil horizontal; digits with dilated tips, an intercalated element between two distal phalanges; terminal phalanges bifurcate; fingers entirely free, without lateral ridges; toes webbed; body and limbs with numerous spiny tubercles; very small metacarpal tubercles; a moderately distinct fold across palate between Eustachian tubes followed by a second less distinct; two well-defined bony ridges from canthus rostralis to back edge of occiput; bony ridges above tympanum; skin of head adherent to bones of skull and at least partially ossified.

I have revived this genus to contain *Hazelia spinosa* Taylor (the type species), and *Ixalus pictus* Peters. The latter species has been found in southern Thailand, while *spinosa*, so far as known, is confined to Mindanao and certain adjoining islands.

I do not doubt that other species, now recognized in the genus *Philautus* will be found to belong in this genus. Two that are suspects are *Rhacophorus anodon* van Kampen and *Ixalus flavosignatus* Boettger. The former at least, has the skin of head adherent to the skull.

Both *H. picta* and *H. spinosa* appear to have the same type of life history. Eggs are placed above holes or cavities in trees containing water. The rain or gravity brings the eggs or hatchlings into the water pockets. Very few eggs are laid. This would appear to be an adaptation to limited food supply in the water cavities.

Although in the type of *H. spinosa* I did not discern distinct ridges on palate in front of esophagus several specimens show one distinct

fold followed by a second distinct fold between Eustachian tube openings.

Wolf (Bull. Raffles Mus., no. 12, 1936), has placed *Hazelia spinosa* as a subspecies of *Rhacophorus leprosus* (*sic.*), a disposition that suggests the author's lack of experience with the Amphibia, and an inclination to indiscriminate lumping.

Ahl has placed *Hazelia spinosa* as a species under *Philautus* which he considers a subgenus of *Rhacophorus*. Inger (1954) follows him (except he maintains *Philautus* as a genus). The tadpoles attain large size before transformation.

### *Hazelia picta* (Peters)

FIG. 79

*Ixalus pictus* Peters, Monatsb. Akad. Wiss. Berlin, 1871, p. 580 (type locality, Sarawak, Borneo); Ann. Mus. Civ. Genova, vol. 3, 1872, p. 44, pl. 6, fig. 2; Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum, 1882, p. 99; Fischer, Arch. Naturg., vol. 51, 1885, p. 43; Mocquard, Nouv. Arch. Mus. Paris, ser. 3, vol. 2, 1890, p. 122; Boulenger, Proc. Zool. Soc. London, 1894, p. 642; Flower, *ibid.*, 1896, p. 908; *ibid.*, 1899, p. 900; Boulenger, Fasciculi Malayenses, Zool., 1903, 172; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 203; Robinson, Journ. Federated Malay States Mus., 1905, vol. 1, pp. 24, 30; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 255.

*Philautus pictus* Barbour, Mem. Mus. Comp. Zool. Harvard Col., vol. 44, 1912, p. 171; M. Smith, Journ. Federated Malay States Mus., vol. 10, 1922, p. 280; van Kampen, Amphibia of the Indo-Australian Archipelago, 1923, p. 269-270; M. Smith, Ann. Mag. Nat. Hist., ser. 9, vol. 18, 1926, p. 78; Bull. Raffles Mus., no. 3, 1930, p. 116 ("Banang Star," Pattani); Bull. Raffles Mus., no. 5, 1931, p. 19; Bourret, Les Batraciens de l'Indochine, 1942, p. 455.

*Rhacophorus (Philautus) pictus* Ahl, Das Tierreich, Lief. 55, Anura III, 1931, p. 84.

**Diagnosis:** A diminutive form (35 mm., snout to vent); interorbital space wider than eyelid; a pair of low bony ridges on each side of interorbital region extending onto occipital region; ridges above tympani; latter distinct; sharp canthus rostralis; fingers completely without web; toes webbed; tongue notched behind; no vomerine teeth; snout narrowed, truncate, extending somewhat beyond lower jaw; skin above covered with granular and spiny tubercles; green in life with cream or orange spots along canthus, neck, and on upper surfaces of arms and legs.

**Description of species** (from B. M. No. 1929.12.24.2 ♂, Bhetong, Yala province): Head rather broad, snout narrowing anteriorly, obtuse or truncate at tip, not sloping forward, extending beyond lower jaws and sloping down and backwards to lip; canthus rostralis sharply defined, nearly vertical; loreal region, slightly concave; nostril almost directly above anterior level of lower jaw very much





FIG. 79.—*Hazelia picta* (Peters). B. M. No. 1929.12.24.2 ♂. Actual snout-vent length, 30.5 mm. Bhetong, Yala, Thailand.

closer to tip than to eye; interorbital distance (4.2 mm.) distinctly wider than an upper eyelid (2.7 mm.); two low bony ridges from about front level of eyes along borders of interorbital area to near back end of occiput; small low bony ridge above tympanum; diameter of tympanum (3 mm.) a little less than length of eye (3.35 mm.); back border of eyelid forming a slight curving flap.

Choanae lateral, large, concealed largely when palate is viewed from point directly below; Eustachian tube openings as large as choanae. Tongue slender, strongly notched behind, free for two fifths of its length; a distinct dermal fold across palate between openings of Eustachian tubes; no vocal sac in male.

Arms moderate; digits elongate, flattened, without trace of web or lateral ridges; first finger shorter than second; all with widened terminal discs with peripheral grooves; width of largest outer discs (1.2 mm.) a little more than a third of diameter of tympanum; distal subarticular tubercles large; proximal ones small; three small metacarpal tubercles; swelling at base of first finger covered with fine nuptial asperities. Legs slender, elongate, tibiotarsal articulation reaching about six millimeters beyond tip of snout; digits with discs smaller than those on fingers; small subarticular tubercles; outer digits about one-third—inner about one-fourth webbed; distinct metatarsal tubercle less than half length of first toe.

Skin on top and side of head, dorsum and to a lesser extent upper surfaces of arms and legs, with rough, scattered granular or spiny tubercles; skin on head especially on dorsal surface adherent to skull bones; skin on chin, breast, sides, undersurface of arms and legs, anterior and part of posterior faces of femur, smooth; no supratympanic fold. Venter with large, somewhat irregularly shaped granules; some granules also in region of vent.

*Color:* In preservative, very light brown on head and dorsum, slightly darker on tip of snout and on rims of the cream or orange spots; a number of small yellow spots on dorsum along canthus rostralis, eyelid, sides of head, neck, and sides of body; on forearm spots arranged in transverse diagonal rows and to a lesser extent the same is true on leg; numerous small cream or yellowish spots on back of thighs and anal region; chin fawn-brown with minute yellow flecks; venter with a brown reticulum enclosing large irregular cream spots; hand, foot, and tarsus with yellow or orange spots.

*Variation:* The tongue may be free for nearly half its length. In the two specimens measured above (from "Valley Contour Path,

Measurements in mm. of *Hazelia picta*

Number.....	2784	2792	1929.12.24.2
Sex.....	?	?	♂
Snout to vent.....	29	28	30.5
Width of head.....	11	10.2	10.9
Length of head.....	12	12	10.9
Arm.....	21	19.5	19.2
Leg.....	45	50	52
Tibia.....	17.5	17.8	17.5
Foot and tarsus.....	18.6	20.2	21

Bukit Timali, Singapore Island") the spots assume a more ocellus-like appearance. They may be orange or cream in color.

One of the specimens was captured on a tree near a small pocket of water, suggesting that this type of habitat may serve as breeding place for the species. The tympanum may be a little smaller in the Singapore specimens than in the single Thai specimen seen (about three fourths as large as eye) and the discs of fingers may be slightly more than half the diameter of the tympanum.

*Distribution:* In Thailand the species has been captured only in the southernmost province of Yala. It is known in Malaya, Borneo and the Mentawi Islands.

*Remarks:* The pupil of the eye is unusual in character. It is a horizontal opening; the upper rim forms a convex line, while the lower rim is strongly sinuous with a pair of elevations on its border.

I have placed this form in *Hazelia* because of numerous characters that set them apart from most other forms of *Philautus*. I have no doubt that certain other forms now regarded as *Philautus* will eventually be placed in this genus. I have suspected that *Philautus anodon* of van Kampen may be such a form. Another that is a suspect is *Philautus flavosignatus* Boettger. I have not examined specimens of these forms.

#### Genus THELODERMA Tschudi

*Theلودerma* Tschudi, Classification der Batrachier . . . (printed separately) and in, Mem. Soc. Neuchâtel, vol. 2, 1939, pp. 32, 73 (type of genus *leporosa*).

I am reviving this name, long in synonymy, for a group of frogs now assigned to *Rhacophorus* and *Philautus*.

*Diagnosis:* Oriental tropical frogs, with very numerous larger or smaller warts studded with ivory-colored tubercles; widened discs

on digits; distinct tympanum, usually without vomerine teeth (present in *leporosa*); tongue variable; toes usually half to fully webbed; fingers with remnant of web to one-half webbed; reduced number of large eggs placed above cavities or holes in trees, filled with water.

Certain of the species develop only four or eight eggs in each ovary, and it may be a characteristic of all the species. Eggs are laid in trees usually on branches or holes above small cavities or pockets of water. Rain or gravity carries the egg or the hatchlings into the water where they develop.

Accounts of this behavior has been reported for certain of the forms, and it is believed to be common to all.

Boulenger quotes the following with the type description of *Ixalus horridus* Fasciuli Malayenses, Zool., vol. 1, 1903, p. 139:

"A considerable number of adults of this species inhabited a tree in the jungle near our camp on Bukit Besar occasionally manifesting their presence by low grunts or croaks, uttered singly at intervals. The tree was one of those from the lower parts of whose trunk large buttresses projected and in its case these buttresses had coalesced in pairs so as to form cavities which contained several gallons of rain water and dead leaves. The frogs deposited their spawn on the trunk in frothy masses about the size of a cricket ball, a foot or two above the surface of the water in these cavities, which was of a deep brown colour. The masses resemble those produced by *Rhacophorus leucomystax* but were smaller and paler in color. I found that if they were not washed down by rain into the water within two or three days the froth dried up and the ova perished. The cavities were haunted by a snake *Tropidonotus chrysargus* two specimens of which were taken feeding on the spawn despite the froth in which it was imbedded."

Under *Theloderma stellatum* I describe the place of deposition of the eggs of that species. The tadpoles taken there developed for some time after being taken back to Bangkok. The eggs taken hatched in the laboratory having been kept in water from the cavity in which they have developed.

*Theloderma gordonii* was taken on the bole of a tree in northern Chiang Mai province. Mr. Young who collected the type specimen on a tree trunk did not observe any water pockets near by.

I regard the following species as probably referable to *Theloderma*.

1. Vomerine teeth present, tongue  
notched posteriorly, no vocal  
sacs.

*corticalis* Boulenger  
*leporosum* S. Müller  
*bicolor* Bourret  
*gordoni* sp. nov.

Vomerine teeth absent

2

2. Vocal sac present.

*stellatum* sp. nov.  
*horridum* Boulenger  
*asperum* Boulenger

Vocal sac absent

Boulenger described the genus *Phrynoderma* largely on the basis of a tongue said to be feebly nicked behind. I have examined the type with Miss Grandison. We agree that at the present time we could not describe the tongue as even feebly nicked. There is no trace of the condition despite the statement and figure given by Boulenger.

This makes it doubtful that this species should be associated with anyone of the three genera, *Philautus*, *Rhacophorus*, or *Theلودerma*.

The species *Phrynoderma moloch* described by Annandale may or may not belong to *Phrynoderma* Boulenger (not of Fitzinger). No description has been given for the tongue, nor detail of the other characters. He states:

"This species differs from *Phrynoderma asperum* Boulenger, the only one hitherto known, in several important characters, notably in the much more pronounced nature of the asperities on its back."

Wolf, 1936, has placed both *moloch* and *asperum* as subspecies of *Rhacophorus leporosus*, evidence of somewhat indiscriminate lumping.

#### KEY TO THAILAND SPECIES OF THELODERMA

1. Vomerine teeth present; chin and throat rough ..... *gordoni*  
No vomerine teeth; chin and throat smooth ..... 2
2. Fingers with web ..... 3  
Fingers without web, canthus feebly distinct; snout as long as orbit;  
tympaanum nearly as large as eye; finger discs large, but smaller than  
tympaanum; blackish above with ashy-gray dots or with a large  
square, or triangular, dark mark on back ..... *asperum*
3. Interorbital space narrower than eyelid; tympaanum as large as eye;  
vocal sac in male ..... *horridum*  
Interorbital space equal to eyelid; canthus rostralis obtuse; tympaanum  
much smaller than eye; no vocal sac in male ..... *stellatum*

*Theلودerma gordoni* sp. nov.

FIG. 80

*Type:* No. 33741. Doi Suthep, above 4000 ft., Chiang Mai, Chiang Mai province; Gordon Young, collector.



*Diagnosis:* Dorsal and lateral parts of body with very numerous large warts covered with small pearly granular asperities; sharp canthus rostralis; interorbital distance at least once and a half times width of eyelid; fingers entirely free, toes little less than two-thirds webbed; tips of all digits dilated but all considerably smaller than tympanum; vomerine teeth present; tongue notched behind; an oval inner metatarsal tubercle; no outer tubercle apparent; snout to vent, 4.8 millimeters.

*Description of the type:* Head flat on top; canthus rostralis well defined; loreal region nearly vertical, concave; length of snout (8 mm.) considerably longer than eye (5.2 mm.); eye to nostril, 5.15 millimeters; nostrils elevated, much nearer end of snout than to eye; tip of snout rounding in lateral profile, extending about one millimeter beyond mouth. Tympanum large, distinct, about four millimeters in diameter, its distance from eye less than half its diameter; width of an eyelid (4.8 mm.), much narrower than interorbital distance; eyes very moderately elevated.

Choanae lateral; vomerine teeth on two ridges beginning near anterior inner border of choanae, directed diagonally, not extending behind choanae, separated from each other by distance greater than length of one group; palatal glands open into distinct transverse groove, closer to anterior level of choanae than to front of palate; tongue a little longer than broad, notched, free behind for half its length, free on sides.

Arm brought forward wrist reaches beyond mouth; fingers free with well-developed discs much smaller than tympanum; fourth finger distinctly shorter than third; three rather large metacarpal tubercles situated at bases of first, third, and fourth fingers; subarticular tubercles well developed, distal ones larger than proximal; toes nearly two-thirds webbed, web reaching terminal discs by narrow fringes; discs surrounded by peripheral groove; prominent oval, moderately large, inner metatarsal tubercle; no outer tubercle, or if present covered with granules as are other surface tubercles in that area and not distinguishable; subarticular tubercles on three outer toes; discs on tips of toes a little smaller than those on fingers; leg brought forward, tibiotarsal articulation reaches eye. Dorsal surface of head, dorsum, dorsal surfaces of arms and legs, with large and small irregular tubercles covered with granules, very rough to the touch; chin, front of breast, and sides with similar but smaller granules; venter and underside of thigh with smooth



FIG. 80.—*Theloderma gordonii* sp. nov. No. 33741. Actual snout-vent length, 48 mm. Doi Suthep, "Above 4000 ft.," Chiang Mai, Thailand.

granules or areolae; smooth areas in groin, axillary region, and underside of tibia.

*Color in life:* Dark wood-brown with darker spots on head; granules on tubercles light gray or cream; an irregular darker area in groin; venter lavender with dark lavender flecks and reticulations, and some larger spots under limbs and on front of thighs; tubercles under digits cream to flesh.

*Measurements in mm.:* Snout to vent, 48; width of head, 20.3; length of head, 21; arm, 33; leg, 67; tibia, 21; foot and tarsus, 29.5.

*Remarks:* The described species is probably most closely related to *Theloderma leporosus*. It differs in having the toes scarcely more than half webbed (not nearly "completely webbed"), the discs about three-fourths the size of tympanum. The inner metatarsal tubercle is rather large, rather than "very small." The tibiotarsal joint reaches to eye rather than to between eye and the tip of the snout. *Theloderma leporosa* is described as "jet black beneath, marbled with pale bluish gray." This also differs from the light lavender-flesh ventral ground-color, with its varied fleckings and reticulations of dark lavender or purplish. Examination of the figure given shows that there is a more or less definite symmetry in the distribution of the dark markings on head and body.

The specimen was captured on a tree trunk in the forest on Doi Suthep. It is named for Mr. O. Gordon Young of Chiang Mai, Thailand, who discovered the specimen.

*Theloderma stellatum* sp. nov.

FIG. 81

*Type:* No. 35441. Khao Sebab (mt.), circa 18 km. NE of Chanthaburi (town) near "the waterfall"; Edward H. Taylor, collector.

*Diagnosis:* Body with very numerous tubercles covered with granular asperities; fingers about one-third webbed, toes about four-fifths webbed; digits with large terminal discs, those on fingers as large as tympanum; canthus not distinct; eye as long as snout; eyelid a little wider than interorbital distance; tibiotarsal articulation reaches to near tip of snout; throat smooth; tympanum distinct, much smaller than eye; subarticular tubercles small. Male with a large pad on dorsal surface of first finger; no vocal sac in male; venter brown mottled and reticulated with cream.

*Description of the type:* Snout seen from above a rather pointed oval; nostrils round, directed upward, area surrounding them forming two slight elevations with a slight depression between them;



FIG. 81.—*Theloderma stellatum* sp. nov. No. 35441. Type. Actual snout-vent length, 34 mm. Khao Sebab, Chanthaburi, Chanthaburi, Thailand.

loreal region slightly concave; in profile snout rounded, projecting about one millimeter beyond mouth; eye large, strongly elevated, as long as or slightly longer than snout. Interorbital distance nearly equals width of eyelid (6 mm.); tympanum large ( $3 \times 2\frac{1}{2}$  mm.), its distance from eye equal to about a third of its width.

Choanae lateral, openings of palatal glands between choanae near their anterior level, not forming a conspicuous groove; tongue as long as wide, deeply notched behind, free for nearly half its length, and free on sides; arms short, wrist not reaching beyond snout; limb

"fixed" in position and cannot be moved forward easily; fingers about one-third webbed with broad terminal discs wider than long; sides of digits with thickened lateral ridges; subarticular tubercles small; palmar (metacarpal) tubercles three, a very small one under first finger and widely separated from this are two contiguous tubercles at base of two outer metacarpals; linear ridge on back edge of forearm; leg laid forward tibiotarsal joint reaches to nostril; toes about four-fifths webbed with a well-developed, rather elongate, oval inner metatarsal tubercle; very small, rather indistinct outer; heels overlap about two millimeters when legs are folded at right angles to body.

Dorsal surface of head and body, sides of head, upper side of forearm, upper surface of tibia, and tarsus, with smaller or larger tubercles covered with granular asperities; thickened paratoidlike swelling above arm-insertion behind eye. Upper surface of femora, with small tubercles, arranged in linear fashion; throat, breast, underside of arms, hands, sides of body, anterior and posterior surface of thigh, undersurface of tibia and tarsus smooth; venter, undersurface and part of posterior surface of thigh with rounded flattened granules, lacking asperities.

*Color in life:* Above brownish or lavender gray, cream-speckled; black spots on snout and one or two between eyes; a trifoliate spot across shoulders, followed by four or five smaller dark spots; a strong black groin spot and one less distinct behind axilla partially visible from above; thigh, tibia, tarsus, and foot with transverse purplish bars contiguous when limb is folded; a purplish spot about vent; underside of chin dark lavender or purplish with numerous tiny whitish flecks; venter and underside of thighs cream with purplish-brown flecks or spots, partially reticulated; terminal discs on digits slightly pinkish; metacarpal and metatarsal tubercles flesh-white; iris with indistinctly radiating lines of black and dark gold; eye with horizontal pupil.

*Measurements in mm.:* Snout to vent, 34; width of head, 14; length of head, 16.4; arm, approx. 20; leg, 51; tibia, 18; foot and tarsus, 22.

*Remarks:* Eggs of this species were found in two masses attached to the trunk of a forest tree, about two feet from the ground, some five inches directly above a small hole in the trunk containing a quantity of black-brown water, colored by rotting wood and leaves. I placed the masses in water and they separated into two groups of eight individual components, each egg  $3\frac{1}{2}$  to 4 mm. in diameter. The



eggs absorbed some water, and when measured were from six to seven millimeters in diameter. From the same pocket of water I recovered some tadpoles hatched from a previous laying.

Eggs and tadpoles were placed in a container and taken to Bangkok together with a quantity of the water from the hole. I hatched the eggs in the laboratory. The young remained in the egg capsules for four or five days. When hatched, the tadpoles remained near the bottom most of the time. They were fed on fragments of dried biscuit.

The absence of a vocal sac would appear to be significant. Where the sac is present, usually a loud voice obtains, which is the means of calling together a breeding group. In this case, there is an extremely limited supply of water and one pair may be the maximum number that can be accommodated.

*Distribution:* The species is known only from the type locality.

*Theloderma horridum* (Boulenger)

FIG. 82

*Ixalus horridus* Boulenger, Fasciculi Malayenses, Zoology, vol. 1, 1903, p. 139, pl. 6, fig. 2 (type locality, Bukit Besar, Pattani); Robinson, Journ. Federated Malay States Mus., 1905, p. 24; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 256-257; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, May 1917 ("Pattani, peninsular Siam").  
*Philautus horridus* M. Smith, Ann. Mag. Nat. Hist., ser. 9, vol. 18, 1926, p. 80 (Mentawi Islands); Bull. Raffles Mus., no. 3, 1930, pp. 116, 118.  
*R[hacophorus] P[hilautus] horridus* Ahl, Das Tierreich, Lief. 55, Amphibia, Anura III, 1931, p. 65.

*Diagnosis:* Prominent irregular warts studded with granular asperities; fingers half webbed; toes fully webbed; tibiotarsal articulation to between eye and tip of snout; tympanum as large as eye; webs of hands and feet black; venter blue-gray, marbled with black; male with vocal sac. Eggs laid in masses of foam on trees above pockets of water *vide* Boulenger. No vomerine teeth.

*Description of type* (after Boulenger): Very similar in general appearance to *Rhacophorus leporosus*, Schlegl. and *R. corticalis*, Blgr.; head rather strongly depressed, obtusely pointed, snout a little longer than diameter of orbit; canthus rostralis obtuse; loreal region concave; nostrils close to end of snout; interorbital space a little narrower than upper eyelid; tympanum distinct, as large as eye. Fingers half webbed, with large terminal discs, which are broader than long; width of discs on outer fingers equals diameter of tympanum; toes webbed to discs, which are smaller than those of fingers; terminal phalanx bifurcates; subarticular tubercles of fingers and

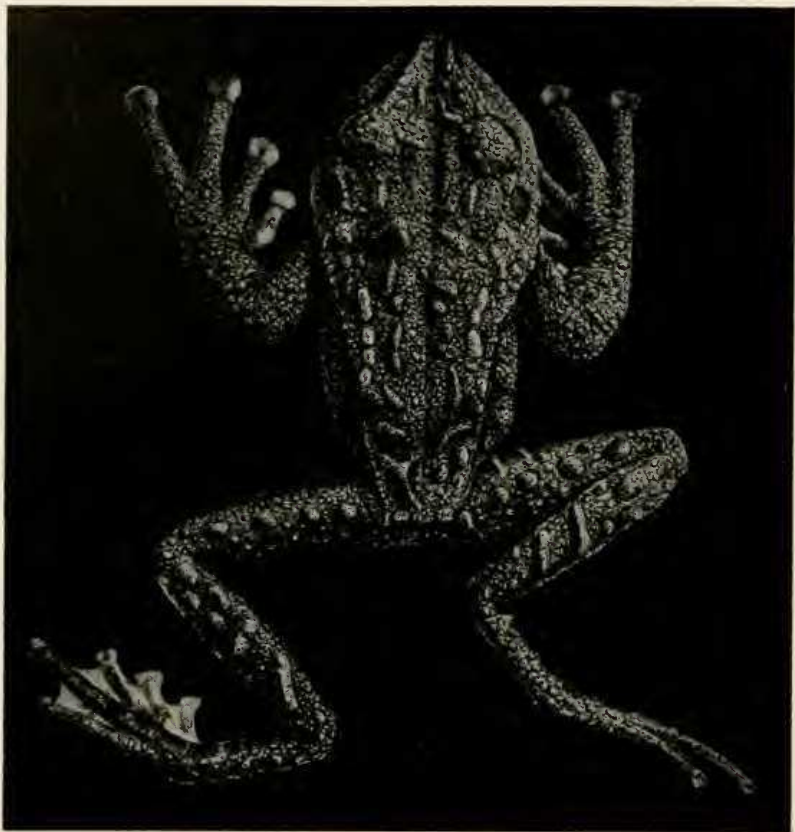


FIG. 82.—*Theloderma horridum* (Boulenger). Type. Actual snout-vent length, 40 mm. Bukit Besar, Pattani, Thailand.

toes very small; small oval inner metatarsal tubercle. Tibiotarsal articulation reaches between eye and tip of snout. Upper parts with very prominent, irregular large warts, themselves studded with granular asperities in adult; throat, breast, lumbar region, antero-femoral region, and lower surfaces of limbs, smooth; belly and anal region with large flat granules. Male with large soft nuptial pad on inner side of first finger, and an internal vocal sac.

*Color in life:* Dark warm-brown above with rather indistinct blackish spots on body and regular crossbars on limbs; granular asperities grayish; large black lumbar spot; webs blackish; lower parts white (bright blue-gray in life) largely spotted and marbled with black.

*Measurements in mm.:* Snout to vent, 40 mm.

*Distribution:* Known only from southern Thailand in the province of Pattani. It probably occurs in Malaya also.

*Remarks:* "The resemblance, both above and below, between this species and *Rhacophorus leporosus*, known from the mountains of Perak, is very close indeed, and is probably an instance of adaptive resemblance or 'convergence,' though the two frogs belong to closely allied genera, seeing that they both differ widely in appearance from the typical members of their respective genera. Their habits appear to be identical, and it is probable that a very close resemblance also exists between their larvae, which live under very similar conditions, but it is not known whether the species are found together. It would almost seem as if there were a physiological connection in these genera between a warty barklike dorsal surface, and a blue-gray belly, mottled with black, as it is most improbable, in consideration of conditions under which these frogs live, with their bellies closely pressed against the bark of trees, that the conspicuous coloration of the ventral surface is an advertisement to enemies." (Quoted by Boulenger, as notes of the collector.)

*Theloderma asperum* (Boulenger)

FIG. 83

*Ixalus asper* Boulenger, Proc. Zool. Soc. London, 1886, p. 416, pl. 39, fig. 1 (type locality, Larut Hills, Perak, 3300 ft. elev.); Sclater, *ibid.*, 1892, p. 347 (Hills between Burma and Siam); Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, pp. 7(310), 37(340); Flower, Proc. Zool. Soc. London, Dec. 1, 1896, p. 908; *ibid.*, 1899, p. 900; Boulenger, Fasciculi Malayenses Zool., 1903, p. 172; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1903, p. 204; Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 24; Annandale, Rec. Ind. Mus., 1912, pp. 7, 16; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, pp. 255-256; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1917, p. 229 (Hills, western Siam).

*Philautus asper* M. Smith, Bull. Raffles Mus., no. 3, 1930, pp. 116, 117 (northern Siam and Annam); Bourret, Annexe au Bull. Inst. Publ., no. 4, 1937, p. 60.

*Philautus asperimus* Bourret, Les Batraciens de l'Indochine, 1942, pp. 465-467, fig. 165.

*Rhacophorus asperimus* Ahl, Sitzb. Ges. Fr. Berlin, 1927, p. 37, 116.

*Rhacophorus philautus asperimus* Ahl, Das Tierreich, Lief. 55, Anura III, 1931, p. 74, fig. 52.

*Diagnosis:* Small frogs (snout to vent, 35 mm.); canthus rostralis not distinct; interorbital distance wider than upper eyelid; tympanum distinct, nearly as large as eye; fingers, with discs, without webs; toes three-fourths (or more) webbed; tibiotarsal articulation to tip of snout. Skin with rough granular tubercles, venter strongly



FIG. 83.—*Theloderma asperum* (Boulenger). Upper figure, B. M. No. 93.10.9.31. Actual snout-vent length, 23 mm. Karin Hills, Burma. Lower figure, B. M. No. 1904.7.19.26, length, 32 mm. Bukit Itam, Selangor, 3000 ft.

granular or areolate; a large dark marking on back. Venter marbled black and bluish gray.

*Description of species* (from B. M. No. 1904.7.19.26, Bukit Itam, Selangor, Malaya): Head broader than body; snout oval, nostril much nearer tip of snout than eye; canthus poorly marked, loreal region oblique, slightly concave; distance between nostrils (2.4 mm.) much less than interorbital distance; length of eye (4 mm.) less than length of snout (4.8 mm.); width of an eyelid (3.1 mm.) less than interorbital width; tympanum large, its diameter (3.15 mm.) less than length of eye, situated very close to eye. No fold from eye above tympanum.

Tongue short and broad, notched strongly behind, free behind for two fifths of its length; choanae moderate, very much smaller than Eustachian tube openings; palatal glands open in a chevron-shaped groove (more or less continuous), just anterior to front level of choanae; choanae not concealed when palate is viewed from below; vocal sac present, the openings small, puckered, near angle of mouth. Arm moderate, but difficult to straighten; fingers with large discs, not as large as tympanum; a web remnant at base of fingers with slight fringes or ridges reaching to discs; a groove across face of disc; first finger shorter than second; subarticular tubercles distinct; supernumerary tubercles present; three distinct metacarpal tubercles, two outer nearly contiguous; toes, with discs smaller than those on fingers, about three-fourths webbed; single small inner metatarsal tubercle; no tarsal fold; subarticular tubercles strong; leg moderate, tibiotarsal articulation reaches more than mid-way between eye and nostril; when legs are folded at right angles to body heels overlap four millimeters.

Skin on dorsal and lateral surfaces with fine pearly-tipped tubercles sometimes in linear arrangement, sometimes forming vermiform lines, sometimes scattered; ventral surfaces of chin nearly smooth, venter with large granules or areolae, underside of thighs and femora smooth; a few tubercles about vent.

*Color:* Dorsal surface of head and body grayish or bluish gray with a small brown line between eyes and some indefinite brown marking on occiput; a darker area under eye extending on to tympanum; an elongate brown spot from shoulder level to rump where it divides, terminating on each side near level of venter, followed behind by a gray area dividing and terminating on base of femora; latter generally brownish, barred with brown, bands with lighter centers, reaching venter level on front of femora but not posteriorly;



some fine cream verniform flecks. Tibia barred with dark brown tending to encircle limb; tarsus and foot barred; ventral surface of chin nearly uniform brown with a few minute whitish flecks. Venter cream, strongly marbled with brown, brownish on underside of arms and limbs.

*Measurements in mm.* (of B. M. Nos. 1904.7.19.26 and 93.10.9.31, latter from Karin Hills): Snout to vent, 32, 23; width of head, 13.2, 9.3; length of head, 12.3, 9; arm, 20.4, 14; leg, 49.2, 34.3; tibia, 17, 12; foot and tarsus, 22, 14.3.

*Variation:* The second specimen measured, from the Karin Hills, differs from the one described in certain characters which may be largely due to the fact that it is a younger specimen. The tubercles are more elevated and fewer. Seemingly the pearly tips are shed and when lost the wartlike tubercles suggests a crater.

The web-remnant on the hands is somewhat less distinct, the gray color is lighter and the dark mark on side of head surrounds the eye and tympanum and extends back beyond axilla; the marks are all deep chocolate-brown.

*Distribution:* Occurs in western Thailand. (M. Smith says northern Thailand also.)

Elsewhere it occurs in Burma, Selangor and Perak in Malaya, and in Indo-China.

*Remarks:* The smaller specimen was collected in the Karin Hills by L. Fea. The larger specimen, a male, has a large nuptial pad on the first finger.

The life history of this species is as yet undescribed. It is presumed that eggs are placed in cavities containing water, in trees.

### Genus *PHILAUTUS* Gistel

*Philautus* Gistel, *Naturgeschichte des Thierreichs* . . . 1848, p. 10 (not seen).

*Diagnosis:* Pupil horizontal; tongue notched behind; vomerine teeth usually if not universally absent; fingers free or webbed at base; outer metatarsals separated by a groove or narrow web; a small intercalated bone or cartilage between last two phalanges in digits.

The difficulty of separating *Philautus* from *Rhacophorus* has been recognized by many workers but most have agreed that *Philautus* must be recognized as a generic group.

The recognition of species within the genus also presents problems, as is evidenced by two recent works: the treatments of the species in the Philippines by Inger 1954 and those in Ceylon by

Kirtisinge 1957. Both works seemingly are somewhat unsatisfactory, either because of unwarranted synonymizing or the describing of new forms without giving them names. In both cases the authors, at the time their studies were made, had had no adequate field experience with this difficult group or with the tropical fauna in general. I, too, have encountered difficulty chiefly from inadequate material. A specimen of a form of *Philautus* in the U. S. National Museum from Khao Sebab, Chanthaburi, not in the best condition, may represent another species of the genus in the Thai fauna.

## KEY TO SPECIES OF THAI PHILAUTUS

1. Small species, 20 mm. or less in total length; snout shorter than orbit; tympanum hidden; males with large vocal sac evidenced by ample skin folds under chin ..... *parvulus*  
 Larger species 24-35 mm. snout to vent length ..... 2
2. Color pattern of dark transverse spots or blotches; arms and legs barred ..... 3  
 Color pattern with parallel cream, yellow, or white dorsolateral lines that may be edged with darker color; no transverse dark bars ..... 4
3. Head distinctly broader than body; eyes protuberant; tibiotarsal articulation to tip of snout or beyond; bar between eyes, one across neck, one behind shoulder another across rump; conspicuous cream spot below eye; snout to vent 35 ..... *bimaculatus*  
 Head not or at most only slightly wider than body, tibiotarsal articulation reaches eye or a little farther; toes three-fourths to four-fifths webbed; canthus angular; tympanum distinct ..... *nongkhorensis*
4. Three dim or distinct darker parallel lines on dorsum rarely also trace of dorsolateral lighter lines; tympanum distinct; a slight tarsal fold; 32 mm. .... *doriae*  
 A pair of yellow, cream, or whitish dorsolateral lines ..... 5
5. Smaller (to 24 mm.); snout pointed; tibiotarsal articulate, reaching beyond tip of snout; scarcely discernible web between fingers; toes about two-thirds webbed; vocal sac present, the slits elongated, ..... *hanseni*  
 Larger to 32 mm. outer two fingers one-fifth webbed; openings to vocal slits short puckered, foot one-half webbed ..... *vittatus*\*

*Philautus parvulus* (Boulenger)

FIG. 84

*Ixalus parvulus* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1892-1893, pp. 339-340, pl. 10, fig. 4 (type locality, Karin Hills).

*R[hacophorus] P[hilautus] parvulus* Ahl, Das Tierreich, Lief. 55, Anura III, Polypedatidae, 1931, pp. 70-71, fig. 48.

**Diagnosis:** Snout shorter than diameter of orbit; loreal region oblique, concave; interorbital region wider than an upper eyelid;

\* I have not been able to examine the type of *vittatus* and am not wholly convinced of the specific distinctness of the two forms, *hanseni* and *vittatus*. Presumably there is a very considerable difference in size.

tympanum hidden; toes webbed at base; tibiotarsal articulation to eye (or to snout-tip); discs large on digital tips. Venter granular; male with large vocal sac.

*Description of species* (from No. 62 ♀ Mai Salat, stream, 4000 ft. elev. headwaters Muang Khawng, Ampur, Me Pang, Chiang Mai): Head a little wider than body, its width about equal to its length; snout about as long as eye; canthus rostralis very obtuse; loreal region sloping obliquely, not or but shallowly concave; width of interorbital space one and one-third times width of an eyelid; nostril about equidistant between eye and tip of snout; fold indicated from eye to point above arm-insertion; tympanum barely indicated, covered with skin.

Cloanae lateral when viewed directly from below, more than half visible; tongue free behind for two fifths of its length, free on sides; (males with very ample vocal sac indicated by heavy folds below on chin; opening into mouth through moderately long vocal slits).

Skin smooth above on head, dorsum, and upper surfaces of limbs; chin smooth (granular in males); venter, lower part of sides, and underside of femur, granular or areolate.

Arms short, digits without webs, tips dilated, two outer large, innermost scarcely wider than digit; first finger fails to reach base of disc of second; distal subarticular tubercles moderate; proximal tubercles not or scarcely indicated; inner metacarpal tubercle distinct, median well defined, nearly as large as inner; palm and sole of foot not granular. Leg short, digits dilated, discs smaller than

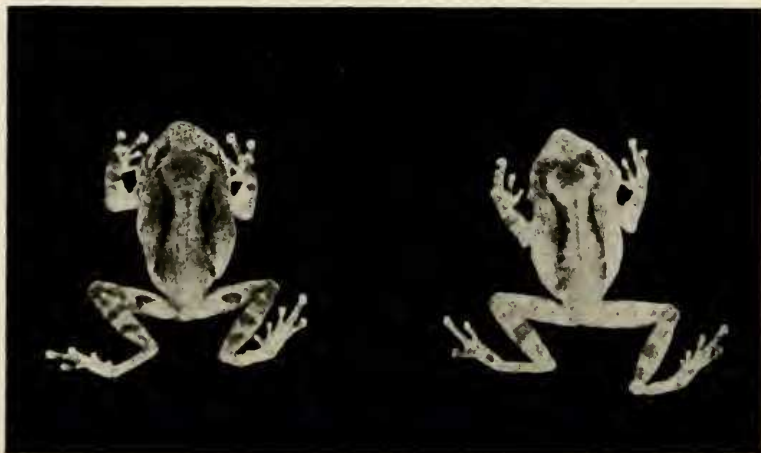


FIG. 84.—*Philautus parvulus* (Boulenger). Left figure, No. 36159a. Actual snout-vent length, 17.2 mm. Right figure, No. 36159 ♂. Length, 18 mm. Doi Suthep, 3000-4000 ft., Chiang Mai, Thailand.

those on hand; proximal and distal subarticular tubercles distinct; three outer digits about one-fourth webbed or less, inner ones with web remnant; inner metatarsal tubercle, no outer; no tarsal fold; tibiotarsal articulation to back edge of eye; when legs are folded at right angles to body, heels barely touch; outer metatarsals completely bound to other metatarsals.

*Color:* Above gray, with an indefinite subtriangular blotch covering part of interorbital area and occiput; two curving lines begin behind eyes extending to middle of back; a black spot on side of rump, with a light area touching it. Arms and legs banded with darker; a dark spot below eye preceded and followed by slightly lighter area. Chin yellowish, flecked with darker; venter and sides darkly pigmented, enclosing small light flecks; underside of arms, legs, hands, and feet, with much pigment except on discs and tubercles.

Measurements in mm. of *Philautus parvulus*

Number.....	62	36144	36148	36150	36151
Sex.....	♀	♂	♂	♂	♂
Snout to vent.....	21	18	18	19.6	18
Head width.....	8.3	7	6.5	7	7
Head length.....	8.6	7	7	6.7	7.1
Snout length.....	3	2.8	2.5	2.3	2.1
Eye length.....	3	2.6	2.6	2.3	2.2
Arm.....	12	12	11.2	11.5	11
Leg.....	29	28.2	26	28	27
Tibia.....	10	9.2	8	9	9
Foot and tarsus.....	12	13	12	11	12

*Variation:* I recently captured a specimen of *Philautus larutensis* on Fraser's Hill in Malaya. I have compared this specimen (a male) with the above males. The measurements are as follows: No. M 30, male; snout to vent, 23; head width, 10.6; head length, 10.5; snout length, 4; eye length, 3.5; arm, 17; leg, 42; tibia, 15; foot and tarsus, 19.

Since the female reaches a length of 35 millimeters, it will be obvious that *larutensis* is quite a different species from the form treated here. The head width and length is much greater (one-third), the arms and legs much heavier and longer proportionally; the webbing of the feet is considerably greater. The shape of the palate differs and the choanae are completely visible seen from below. There is no external evidence of a large vocal sac on chin.

The skin on the chin of the male is strongly but finely granulate.

On the venter and under the thighs the granules or areolae are large. In the female described the throat is completely smooth, the under-side of the thighs smooth, while the granulation is scarcely visible on venter.

*Distribution:* In Thailand the described species has been taken only in the province of Chiang Mai.

*Remarks:* The specimens which I found on Doi Suthep were in low trees, shrubs, low plants, or occasionally on the ground probably having been dislodged from a higher perch. They are especially common from 3000 to 5000 ft. elevation on the mountain. These are often so far from water that one suspects that the species does not have a free swimming tadpole stage. However, I have not found the eggs and do not know where they are placed. Ovarian eggs are relatively large. I have never taken a specimen near water.

I noted that there were two distinctive calls and considered two species were involved. In the field I was presumably able to separate the material into two lots. Unfortunately at the present time all the specimens are not available for study. Two forms may actually be represented. There is a possibility that this is the species reported from Thailand by authors as *P. petersi*.

*Philautus hansenae* Cochran

FIG. 85

*Philautus hansenae* Cochran, Proc. Biol. Soc. Washington, Dec. 2, 1927, vol. 40, pp. 181-182 (type locality, Nong Khor, southeastern Thailand); Proc. U. S. Nat. Mus., vol. 77, 1930, p. 6 (Nong Khor and Ban Sadet).

*R[hacophorus] C[hirixalus] hansenae* Ahl, Das Tierreich, Lief. 55, Anura III, Polypedatidae, 1931, pp. 103-104.

*Chirixalus hansenae* Bourret, Les Batraciens de l'Indochine, 1942, pp. 475-476.

*Diagnosis:* Diminutive species (males to 24 mm.); tympanum equal to one third or less of length of eye; snout pointed, reaching farthest forward at level of nostril, extending beyond mouth; chin and breast smooth; scarcely discernible web between fingers; largest finger discs larger than tympanum; feet about two-thirds webbed; heel reaches to eye; openings of vocal sac elongate slits; row of glandules across anal flap.

*Description of species* (from 36208 ♀ Paeng Kang Tao): Head moderate, eyes prominent, their length about equal to length of snout; latter bluntly pointed extending about one millimeter beyond mouth; canthus rostralis obtuse; loreal region slightly oblique, somewhat concave; width of upper eyelid little less than width of interorbital space; fold from eye runs diagonally back across upper



edge of tympanum, terminating somewhat above arm-insertion; tympanum distinct, its diameter slightly less than half length of eye.

Choanae lateral at least half visible when viewed directly from below; tongue rather elongate, free behind for two fifths of its length, free on sides; no papilla. Faintly visible ridge extending diagonally inward from near upper edge of choanae.

Skin practically smooth on dorsum, upper part of sides and on limbs; below, throat glassy smooth; breast smooth; venter and underside of thigh granulate, largest granules on underside of thigh; small median groove extending down from vent.

Arm short, first finger shorter than second (reaching only to disc); discs on two outer fingers much enlarged, at least equal to diameter of tympanum; none or but slightest web-remnant between fingers; distal subarticular tubercles moderately developed, proximal ones cannot be distinguished from granules on palm; inner metatarsal tubercle moderately distinct, others practically indistinguishable from granules of palm. Leg short, tibiotarsal articulation reaching between eye and nostril; toes with discs, largest equal or less than



FIG. 85.—*Philautus hansenae* Cochran. No. 1021 ♂. Actual snout-vent length, 21.5 mm. Chalermklaub, Siracha, Chon Buri, Thailand.

that on second finger; toes about three-fourths webbed; small inner metatarsal tubercle; no tarsal fold; when legs are folded at right angles to body, heels overlap about two millimeters.

*Color:* Dorsum with rather distinct cream dorsolateral stripe bordered on each edge with two violet to lavender streaks, the lower violet streak extending to tip of snout, widening behind eye; a median stripe from occiput to rump; dim darker line on head crossing upper eyelids; between stripes ground color light lavender.

Measurements in mm. of *Philautus hansenae*

Number.....	36208	36219	26209	36228	36315	34962	1021
Sex.....	♀	♀	♀	♂	♂	♀	♂
Snout to vent.....	24	23	24	21	21.5	23	21.5
Snout length.....	3.4	3.3	3.3	3	3	3.4	3
Eye length.....	2.95	3	3	3	3.1	3.1	3.3
Width of head.....	7.7	7.4	6.8	6.1	6	7.2	7.8
Length of head.....	8.3	8.3	8	7.2	7	8	6.8
Arm.....	14	14	14.3	11.4	12	13	12
Leg.....	37	38	34.5	32.9	34	35.3	33
Tibia.....	12.0	12	11.8	10.4	10.8	12	10.5
Foot and tarsus....	16	16	16	14.2	14.3	16	14

No. 34962, Phu Kading, 3000 ft. Loei Prov. No. 1021 Chalermklarb, Chon Buri. All others from Kaeng Pang Tao, Chiang Mai prov.

*Variation:* Some of the specimens from Chiang Mai are brownish rather than violet or lavender. No. 36221 is brown, the area from occiput to rump with thickly scattered small white-topped pustules. These are not evident in any other specimen. No. 34962 is only faintly colored above, the stripes scarcely evident. The tips of the fingers and toes are a little smaller than in the other specimens. In Nos. 36226, 36228 (Chiang Mai) the darker lines tend to be broken and the area between them has numerous darker flecks.

*Distribution:* The species is known from Chanthaburi, Chon Buri (Chalermklarb); Loei (Phu Kading); Chiang Mai (Nong Pu'ng and Kaeng Paeng Tao). Most of the specimens were taken from small rain pools or ponds chiefly in lowland forest. One exception is a specimen taken at Phu Kading at an elevation of about 2800 ft.

*Remarks:* This species superficially looks like *Philautus doriae*, however, the following differences would seem to preclude its being regarded as the same species: Distinctly smaller; proportionally larger eyes; sharper snout coming to a "point" at a higher level; a slightly smaller tympanum; reduction of the webbing between fin-

gers; the absence of the rows of glandules on anal flap and the more elongate openings of vocal sacs into the mouth.

Three of the females are gravid. Specimens taken at Chalermklarb were in the same pool as *Philautus nongkhorensis*. The small "blue spots" near end of rump are small masses of dark material below the skin (not impossibly pigment and refuse resulting from absorption of the larval tail). It is not superficial, and when dissected it may easily be removed in the form of a small nodule. The eggs are relatively large.

I examined the types in the United States National Museum. Of the paratype series Nos. 70110-70116, only two female specimens remain, both containing numerous eggs. In one the snout is pointed, the nostril practically equidistant between the eye and the nostril. The black dorsal spots are present near end of rump.

No. 70135, is from Ban Sadet, with large eggs. The "nose" is shorter, the nostril nearer the tip of the snout than to the eye. When the palate is seen from below, the choanae are largely concealed

*Philautus vittatus* (Boulenger)

*Ixalus vittatus* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 5, 1887, p. 421, pl. 4, fig. 2 (type locality, Bhamo, Burma); The fauna of British India, Ceylon and Burma . . . Reptilia and Batrachia.

*Philautus vittatus* M. Smith, Rec. Ind. Mus., 1924, vol. 26, p. 141, pl. 7, fig. 4. *R[hacophorus]* (P.) *vittatus* Ahl, Das Tierreich, Anura III, Lief. 55, 1931, pp. 90-91.

*Diagnosis:* Body rather slender, elongate (snout to vent, 32 mm.); eyes prominent, outer finger less than one-fifth webbed; terminal discs of third finger larger than others, equal in size to tympanum; foot about one-half webbed, first finger smaller than second; eyelid about equal to interorbital distance; tympanum distinct; body brown or grayish violet with two lateral and three dorsal gray or violet stripes; snout as long or longer than eye.

*Description of species* (from No. 36206 ♀, Kaeng Pang Tao, Chiang Mai): Head not wider than body, snout pointed, little longer than eye; canthus rostralis obtusely rounded, loreal region slightly oblique, not or scarcely concave; tympanum distinct, its diameter (2 mm.) about half length of eye, separated from eye by less than half its diameter; fold from corner of eye runs back diagonally across upper part of tympanum and terminates some distance above arm-insertion.

Choanae lateral, not visible when palate is viewed directly from below; tongue free for two fifths of its length and on sides; (male

with a vocal sac opening into mouth by two small narrow puckered vocal slits).

Skin smooth without dorsal or lateral tubercles on body and limbs; chin and underside of limbs with fine granulation; venter and under thigh with larger granules or areolae; transverse row of glandules on anal flap a little above vent; median groove extends down from vent; breast nearly smooth.

Arms rather short, finger tips dilated into large discs, that on fourth finger as large as tympanum. First finger shorter than second, two outer fingers less than one-fifth webbed; vague remnant of web between second and third; no web between two inner fingers; distal subarticular tubercles large, proximal ones small; metacarpal tubercle at base of first finger rather indistinct; other tubercles scarcely distinguishable from granules on palm; toes with discs smaller than those on outer fingers, about three-fourths webbed; small inner metatarsal tubercle, no outer; subarticular tubercles moderately distinct, outer metatarsals not separated except a little anteriorly; no tarsal fold; tibiotarsal articulation reaches to front level of eye; when legs are folded at right angles to body, heels overlap about two millimeters.

*Color:* Above violet-brown with a series of three rather indistinct violet stripes, median arising near tip of snout, dorsolateral ones from eyes; lateral stripes from snout through eye to near groin; chin, venter, breast, and concealed parts of limbs cream-yellow with a vague scattering of pigment on chin and back part of thighs.

*Variation:* Occasional specimens show a tendency toward secondary stripes between the major ones, while in some others they fade out leaving the specimen a dull fawn with very little cloudy pigmentation.

Measurements in mm. of *Philautus vittatus*

Number.....	36204	36206	36210	36203	36214	36229
Sex.....	♀	♀	♂	♂	♂	♂
Snout to vent.....	32	31	28	27	27	26
Eye length.....	4.1	4	4.5	4	4	3.8
Snout.....	5	4.4	4	4	4	3.5
Width of head.....	10.3	10	9.6	8.8	9	9
Length of head.....	12	10.5	11	10	10	10
Arm.....	19.6	17.6	17	15	15.2	15.2
Leg.....	50.4	48.3	42	42.3	42	40
Tibia.....	17	16.7	15.4	14.7	14	14.2
Foot and tarsus.....	22.2	22	19	18	16.6	17

*Philautus nongkhorensis* Cochran

FIG. 86

*Chirixalus doriae* (not of Boulenger) M. Smith, Proc. Zool. Soc. London, 1924, p. 226.

*Philautus nongkhorensis* Cochran, Proc. Biol. Soc. Washington, vol. 40, Dec. 2, 1927, pp. 179-181 (type locality, Nong Khor, southeastern Thailand; Proc. U. S. Nat. Mus., vol. 77, p. 6).

*R[hacophorus] C[hirixalus] nongkhorensis* Ahl, Das Tierreich, Lief. 55, Anura III, Polypedatidae, 1931, p. 107.

*Rhacophorus (Chirixalus) striatus* Ahl, Zool. Anz., Leipzig, vol. 87, 1930, p. 229 (type locality, Karin Hills, Burma); Das Tierreich, Lief. 55, Anura III, Polypedatidae, 1931, 103 (*fide* Bourret).

*Philautus nongkhorensis* Bourret, Les Batraciens de l'Indochine, 1942, pp. 473-474.

**Diagnosis:** Moderately large (snout to vent 38 mm.). Head generally wider than body (gravid females excepted); eye large protruding, longer than snout; canthus rostralis angular; outer fingers two-thirds webbed; toes nearly entirely webbed, their discs smaller than fingers; inner metatarsal tubercle, no outer; skin generally with fine rounded tubercles; belly and much of concealed part of thigh granular; male with a vocal sac.

**Description of species** (from No. 1073, Chalermjarb in Royal Forest, Siracha, Chon Buri): Eye large, its length (4.8 mm.) a little greater than snout length (4.6 mm.); loreal region somewhat oblique, shallowly concave; tip of snout with a very small rounded "nose" little above median notch in upper lip; canthus distinct, nostril nearer tip of snout than to eye; interorbital distance (4 mm.) greater than width of an upper eyelid; strong fold from eye running straight back diagonally, covering upper edge of tympanum and terminating some distance above arm-insertion; tympanum entirely distinct except upper edge, its diameter (2.15 mm.) less than half of eye length; choanae lateral, when viewed from directly below, largely concealed by maxillary shelf; palate strongly arched; tongue large, deeply forked, without papilla, free for little more than half its length; (males with vocal sac opening through elongate slits into mouth). Arm rather short, fingers flattened, tips widened into strong discs, those of two outer fingers largest, equally as large as tympanum; two outer fingers scarcely more than one-third webbed; a basal remnant only between second and third, and first and second fingers; first and second fingers equal or second slightly longer; large inner metacarpal tubercle; other tubercles scarcely distinguishable from granules on palm; distal subarticular tubercles large, proximal ones much smaller; two inner fingers at least partially opposable to outer two. Leg short, tibiotarsal articulation reaching





FIG. 86.—*Philautus nongkhorensis* Cochran. Upper figure, No. 1069. Actual snout-vent length, 31 mm. Lower figure, No. 1076, length, 35 mm. Chalermklarb, Sracha, Chon Buri, Thailand.

middle of eye; toes three-fourths to four-fifths webbed, discs all smaller than those on outer fingers; an inner metatarsal tubercle, no outer; faint lateral tarsal fold (or thickening of skin) along edge of tarsus; subarticular tubercles moderately developed; sole granular; when legs are folded at right angles to body, heels overlap three millimeters.

Skin appearing rather smooth, but with small scattered tubercles especially about head, behind jaw angle, and on posterior face of arm; chin very finely tuberculate; venter and entire underside of thigh (to knee) granulate; granules large, pavementlike, on venter, largest just back of breast.

*Color:* Light lavender-brown with triangular spot on eyes and occiput; an indefinite blotch on middle of back with fine black flecks; dim mark surrounding back of rump; chin with slight pigmentation on jaws; venter white without pigment; sole of foot with some pigment but none on palm; side of head violet; lip somewhat lighter but without distinct cream or white spots.

Measurements in mm. and data of *Philautus nongkhorensis*

Number. ....	1073	1075	902	1066	1069	1133
Sex. ....	♀	♀	♀	♂	♂	♂
Snout to vent. ....	35	36.4	36	32	31	29
Width of head. ....	12	12.2	12.2	10	10	9
Length of head. ....	13.4	13.3	11.2	9.7	10.2	10
Length of eye. ....	4.8	4.9	4.8	4.9	4.6	4.1
Length of snout. ....	4.6	5.3	4.9	4.5	4.3	4.1
Arm. ....	18.2	23.1	23.2	17.5	15.2	16
Leg. ....	54	58	55.5	45	45	45
Tibia. ....	18	20	20	15.1	16	15
Foot and tarsus. ....	24.8	25.2	25	19	18.3	20
Heel to—.....	eye	eye	eye	eye	eye	eye

*Variation:* There is variation in the details of the distribution of pigment on the back, and in the distinctness of the spots.

No. 902 ♀. In this specimen there is a small black mark across the snout before the eyes, connecting with dark violet-brown spots (or stripes) on side of the snout. A band between the eyes is connected with a mark extending from the interorbital region onto occiput and in turn connecting with a dark figure enclosing a diamond-shaped lighter violet area. This connects with a large blotch back of the shoulders and has a continuing narrow median stripe to rump where it widens. A narrow streak crosses back of rump. The legs and arms are strongly barred.

It will be seen from the table of data that the head is nearly as long as wide, perhaps longer in females and slightly shorter in males. The head-width measurements do not include the eyes which stick out beyond the outline of the head.

*Distribution:* All of my specimens are from southeastern Thailand taken at a large logging camp at Chalermjarb, Siracha, Chon Buri.

*Remarks:* No. 902, a female, was taken, clasped by a male, as she was depositing eggs in a foamy mass at the water surface while clinging to a small partly submerged stick. Most specimens were found perched in shrubs and weeds about the periphery of rain pools.

*Philautus bimaculatus* (Peters)

FIG. 87

*Leptomantis bimaculatus* Peters, Monatsb. Akad. Wiss. Berlin, 1867, p. 32 (type locality, upper reaches of the Agusan River, Mindanao, Philippine Islands).

*Ixalus bimaculatus* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd Ed., 1882, p. 106.

*Ixalus bimaculatus* Boulenger, Proc. Zool. Soc. London, 1898, p. 475; Boettger, Ber. Senckenb. Ges., 1886, p. 123; Abh. Ber. Mus., Dresden, 1898-1899, no. 1, p. 3.

*Philautus bimaculatus* Stejneger, Proc. U. S. Nat. Mus., vol. 28, 1905, p. 347; Barbour, Mem. Mus. Comp. Zool. Harvard Col., 1912, p. 171; Taylor, Phil. Journ. Sci., vol. 16, 1920, pp. 296, 305; van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, p. 269; M. Smith, Bull. Raffles Mus., no. 3, 1930, pp. 116-117, fig. 8 (Setun, SW of Phatthalung, and Tasan, Chumphon); Inger, Fieldiana Zool., vol. 33, no. 4, 1954, pp. 399-401 (*part.*).

*Rhacophorus (Philautus) bimaculatus* Ahl, Das Tierreich, Lief. 55, Anura III, 1936, p. 64.

*Diagnosis:* A medium-sized *Philautus*; head broad, well defined; arms short, tibiotarsal articulation to tip of snout; sides and groin dark purplish-lavender with numerous cream flecks; back of thigh and underside of tibia dark lavender with cream flecks; outer fingers about three-fourths webbed; no tarsal fold.

*Description of species* (from B. M. 1927, 4, 21, 10 "Setun." Thailand): Head width 12.6 mm. greater than length (11 mm.); canthus rostralis distinct, the loreal region somewhat oblique, shallowly concave; in front of nostrils snout bends down with a distinct rimmed depression at tip; upper eyelid distinctly narrower than interorbital area; tympanum small (2 mm.) less than half of eye length (4.3 mm.); straight diagonal fold from eye to above arm becoming widened and terminating in a prominent glandular enlargement behind angle of jaws; no vomerine teeth; choanae large, lateral, when palate is viewed directly from below the outer part of choanae concealed by maxillary shelf; tongue rather elongate, very



FIG. 87.—*Philautus bimaculatus* (Peters). B. M. No. 1927.  
4.21.10 ♂. Actual snout-vent length, 32 mm. "Setun" =  
?Setul, Thailand.

strongly bifid posteriorly and free for more than half its length; vocal sac present, the openings elongate (or at least skinfold covering opening) half length of jaw; palatal roof high; distinct openings of palatal gland not evident.

Arm short when brought forwards, fingers reach beyond snout; first finger opposes other three, actually longer than second but when placed side by side they reach same distance; discs of three outer fingers large, equal to or slightly larger than tympanum; fingers one and two, one-fourth webbed; two and three, one-half webbed; two outer fingers nearly three-fourths webbed, the webs continuing as slight fringes or ridges to discs; strong subarticular

tubercles; strong inner metacarpal tubercle, two other much smaller tubercles, outer at termination of a fold along outer finger; several supernumerary tubercles. Toes about three-fourths webbed, web continuing to discs as narrow fringes, discs smaller than those on fingers; a distinct fold along outer toe; a small inner metatarsal tubercle, none or only a very indefinite outer; no tarsal fold; discs with a deep peripheral groove with a strong groove across face of disc; tibiotarsal articulation reaching three millimeters beyond tip of snout; legs folded at right angles, heels overlap four millimeters; subarticular tubercles and some indefinite supernumerary tubercles. Skin smooth on head, eyelids, dorsum, sides and limbs; chin and breast with a very elaborate reticulation of grooves; venter and part of underside of thigh granulate or areolate, the individual granules varying much in size.

*Color:* Front half of head and snout buff; a cinnamon brown narrow bar between eyes; dorsum darker gray-brown with a light-edged brown bar across neck, one behind shoulder and a third across rump; lower part of sides, front and back of thigh, underside of tibia, lavender-violet with cream or yellow flecks; dorsal part of leg brownish-gray with four or five brown bars on femur, three on tibia; bars indefinite on foot and tarsus. Chin gray-white, venter yellowish white, growing darker posteriorly; underside of femur indefinite brownish flesh with a few cream dots below vent. Very conspicuous cream spot below eye.

*Measurements in mm.:* Snout to vent, 32; width of head, 12.6; length of head, 11; arm, 18.2; leg, 58; tibia, 19; foot and tarsus, 26.

*Variation:* It is difficult to ascertain the variation occurring in the species. Dr. Inger has synonymized *Philautus zamboangensis* with this species. This is a doubtful association as shown by the differences mentioned. The arm, especially, is shorter\* and the coloration of *zamboangensis* differs materially.

*Distribution:* It would appear that the species occurs in the southern part of peninsular Thailand from the Isthmus of Kra south. It has been reported from Tasan, Chumphon, and "Setum, SW Phattalung" (perhaps now in the province of Setul?). It has been reported from Sarawak, Borneo, and Mindanao.

\* Inger's elaborate argument for placing the species in synonymy contains at least one gross error. It appears that Inger did not see my type or a single specimen of *bimaculatus*. He states: "Two remaining points cited by Taylor involve characters that exhibit sufficient variation in other species of *Philautus* to account for the differences between the two types. These are the amount of webbing on the foot and the distance between the nostrils. The final distinction of the forelimb appears to be wholly unfounded, for Peters did not mention this character at all"(!). If Dr. Inger had had someone translate the type description for him he would have found that Peters *did* mention the forelimb. He gives the measurement of the forelimb as 25 mm.; of the hind limb, 62 mm.



*Philautus doriae* (Boulenger)

FIG. 88

*Chirixalus doriae* Boulenger, Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1892, p. 34, pl. 10, fig. 5, 5a (type locality, Karin Bia Po, and Thao Karin Hills); Proc. Zool. Soc. London, 1894, p. 642; Fea, Ann. Mus. Civ. Genova, ser. 2, vol. 17, 1897, p. 96 (476); Schenkel, Vehr. Ges. Basel, vol. 13, 1901, p. 150; Annandale, Rec. Ind. Mus., vol. 8, 1912, pp. 7, 18; M. Smith, Proc. Zool. Soc. London, 1924, pt. 1, p. 226 (Nong Khor, Thailand, Ban Khen, Me Wang Forest, N. Siam).

*Rhacophorus (Chirixalus) doriae* Ahl, Das Tierreich, Lief. 55, Anura III, pp. 105-106, fig. 67.

*Philautus doriae* Pope, Bull. Amer. Mus., vol. 61, 1931, p. 582, fig. 34 (Nodoa, Hainan); Pope and Boring, Peking, Nat. Hist. Bull., vol. 15, 1940, pp. 49, 72.

**Diagnosis:** Small species (35 mm.); pupil horizontal; tongue free, deeply notched behind; no vomerine teeth; tympanum distinct. Fingers webbed at base, the two inner opposed somewhat to two outer; toes webbed; digit tips dilated into large discs. Outer metatarsals separated by a web; canthus obtuse; tibiotarsal articulation to eye.

**Description of species** (from No. 29426 B, Karin Bia Po, cotype): Small frogs (35 mm.); snout obtusely pointed, tip extending very slightly beyond mouth; eye large (4 mm. long), its length greater than length of snout (3.3 mm.); canthus obtuse; loreal region vertical, slightly concave; distance between nostrils (2.85 mm.) less than interorbital distance (3.85 mm.); width of eyelid (2.2 mm.) smaller than interorbital distance; tympanum distinct, close to eye, its diameter (1.7 mm.) more than half length of eye; straight skinfold from eye runs across tip of tympanum and terminates behind level of arm-insertion; choanae moderately large, lateral, concealed by maxillary shelf when palate is viewed from below; no vomerine teeth; palatal glands open mesially at anterior level of choanae; tongue very strongly notched behind, the "horns" elongate, tongue free for nearly half its length; openings of vocal sac puckered, beside angle of mouth; openings of Eustachian tubes as large as choanae; skin smooth on head, dorsum, and on limbs; chin and throat corrugated or finely granular. A distinct fold across breast; venter and underside of thighs strongly and uniformly granular or areolate; row of glandular tubercles above vent; few indefinite ones about vent.

Arm moderate, digits with widened tips, with peripheral grooves; a small web between two outer fingers; two inner fingers opposed to two outer; subarticular tubercles large; a large but rather indistinct inner metacarpal tubercle, outer ones not distinguishable; diameter of largest discs nearly equal to diameter of tympanum;

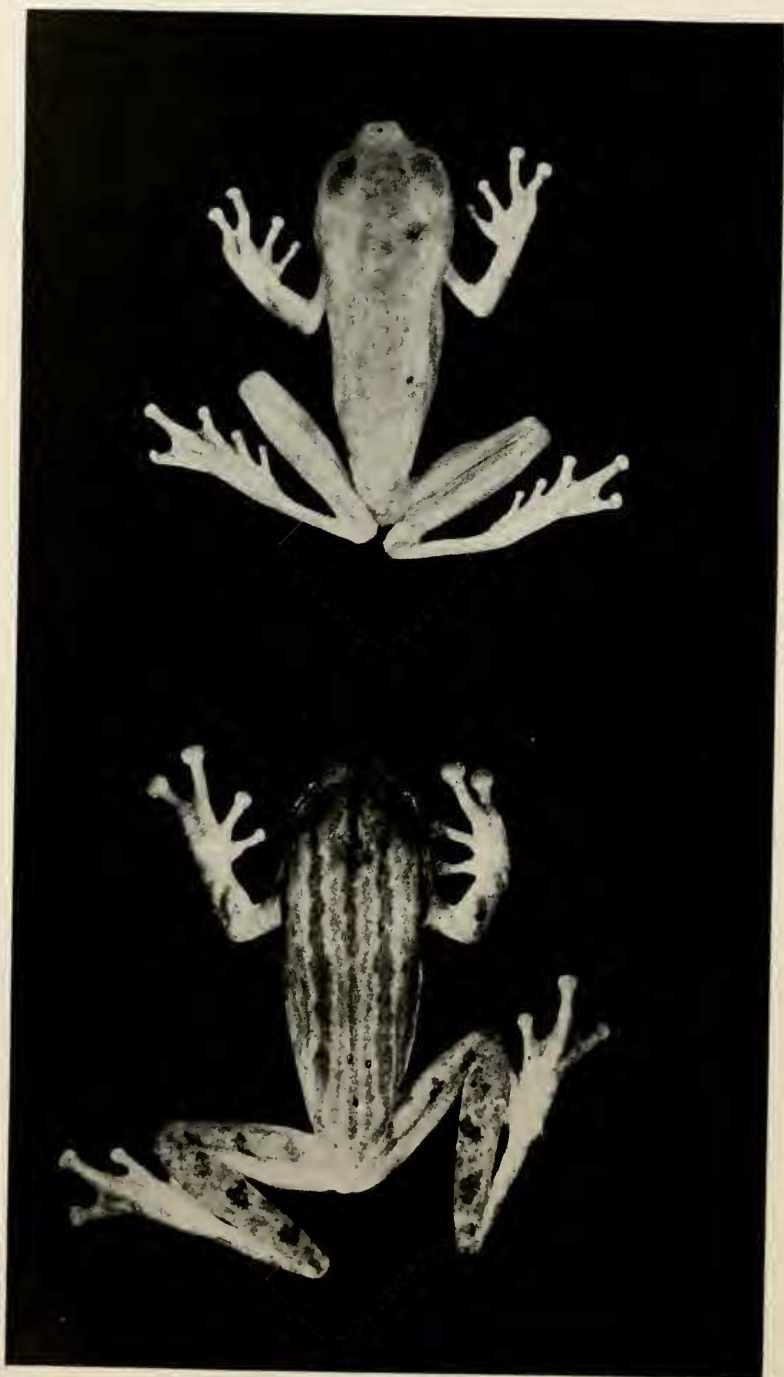


FIG. 88.—*Philautus doriae* (Boulenger). Upper figure, No. 33135. Ang Hin, Chon Buri. Lower figure, No. 33234. Ang Hin, Chon Buri, Thailand.

leg rather short, tibiotarsal articulation reaches slightly in advance of eye; when legs are folded at right angles to body, heels overlap three millimeters; outer toes a little more than half webbed, only a remnant between first two; subarticular tubercles well developed; a small but distinct inner metacarpal tubercle; a slight lateral tarsal fold or ridge indicated; discs on toes smaller than those on fingers.

*Color:* Purplish-gray above, nearly uniform with three dim stripes from tip of snout (median) and eyes (dorsolateral); loreal and tympanic region about same shade as dorsal stripes. A narrow yellow line on edge of upper jaw; chin, breast, venter, and under-side of limbs yellowish to yellowish white; row of glands above vent creamy white.

*Measurements in mm.:* Snout to vent ♂, 26; width of head, 9; head length, 8.2; arm, 15.3; leg, 40; tibia, 8.8; foot and tarsus, 17.

*Variation:* A series of specimens taken at Kaeng Peng Tao, northern Chiang Mai province agree in detail with the descriptions of the cotypes. Two are females and two are males. Their snout-to-vent measurements are, 29, 32, and 26, 28 millimeters, respectively. Specimens from Phu Kading likewise agree in essential details.

*Distribution:* In Thailand the species is known from Chiang Mai province and from Phu Kading, Loei province. Malcolm Smith's report of the species from southeastern Thailand (Nong Khor, 1924) is most probably Cochran's *hansena* from the same locality.

## FAMILY MICROHYLIDAE

### Genus MICROHYLA Tschudi

*Microhyla* Tschudi, Mem. Soc. Sci. Neuchâtel, vol. 2, 1839, pp. 28, 71 (type of genus *Hylaplesia achatina* Boie, = *Microhyla achatina* Tschudi); Parker, Monograph of the Microhylidae, 1934, pp. 123-127.

*Diagnosis:* "Prevomer divided, postchoanal portion lost; palatine present or absent. No clavicles, procoracoids or omosternum; sternum cartilaginous. Vertebral column diplasiocoelous. Terminal phalanges simple, or T-shaped.

"Pupil circular. Tongue oval, entire or free behind. One or two dermal ridges across the palate in front of the pharynx, smooth or crenulate. Digits with or without terminal dilations." (Parker.)

The American and Asiatic species of these small microhylids have been united under the single genus *Microhyla* by Parker (1934). It is a prolific genus and at least eight species are recognized in our territory. For the most part the species are lowland forms, but some at least reach an elevation above 5000 ft.

The frogs of the genus *Microhyla*, because of their small size appear to be difficult to classify, since it is usually necessary to have a lens or microscope in order to see many of the characters clearly. The variable color and pattern likewise tend to confuse. The following key, however, will separate most if not all Thai specimens into their proper species.

#### KEY TO SPECIES OF MICROHYLA IN THAILAND

1. One metatarsal tubercle (inner) ..... 2  
Two metatarsal tubercles (inner and outer) ..... 5
2. Toes webbed ..... 3  
Toes without webs ..... 4
3. Toes two-thirds to three-fourths webbed; leg very long, the tibiotarsal articulation reaching much beyond tip of snout; digits with well-developed discs each having a dorsal notch and groove; very small species, 18 mm. snout to vent ..... *annectens*  
Toes three-fourths webbed; leg moderate, the tibiotarsal articulation reaching tip of snout; discs with a notch and cleft above. Grayish with an angular blotch in middle of back ..... *annamensis*
4. Larger species, 31 mm.; leg shorter, tibiotarsal articulation fails to reach eye; tips of digits swollen but not widened into discs. Normally with well-rounded spots or nearly uniform gray; outer metacarpal tubercle behind the median; supernumerary tubercles on palm, ..... *inornata inornata*  
Similar to the above but a little smaller with three straight continuous or broken lines on back ..... *inornata lineata*
5. Tips of digits swollen, without discs, the upper surface not notched or grooved; no peripheral groove about disc ..... 6  
Tips of digits widened into discs which are notched above, with a median cleft, and peripheral groove ..... 7
6. Two metacarpal tubercles, outer large; toes about one-third webbed, ..... *pulehra*  
Three metacarpal tubercles, the median smallest, the inner and outer usually touching behind median ..... *ornata*
7. Toes less than one-third webbed, with sharp lateral fringes; a continuous black stripe along side of body; a pair of small black marks in middle of back ..... *heymonsi*  
Toes one-third to fully webbed ..... 8
8. Toes at least one-third webbed, the toes with lateral fringes to discs, the tibiotarsal articulation reaches to nostril; small species, 23 mm., ..... *butleri*  
Toes four-fifths to fully webbed, discs large; tibiotarsal articulation to tip of snout or a little beyond; large species, 35 mm. .... *berdmorei*

#### *Microhyla annectens* Boulenger

*Microhyla annectens* Boulenger, Ann. Mag. Nat. Hist., ser. 7, vol. 6, 1900, p. 188 (type locality, Larut Hills, Perak, Malaya, 4000 ft. elev.); Butler, Proc. Zool. Soc. London, 1902, p. 189; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1904, pp. 389-390; Boulenger, Fasciculi Malayenses, Zoology, 1903, p. 172; Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 23; Boulenger, A vertebrate fauna of the Malay Peninsula, . . .

Reptilia and Batrachia, 1912, p. 262 (*part.*); M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1916, p. 169; *ibid.*, 1917, p. 230; Barbour, Occ. Papers Mus. Michigan Univ., no. 76, 1920, p. 3 (*part.*); van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, p. 156 (*part.*); Nieden, Das Tierreich, Lief. 49, Anura II, Engystomatidae, 1926, pp. 28, 32 (*part.*); Parker, Ann. Mag. Nat. Hist., ser. 10, vol. 2, 1928, p. 482; M. Smith, Bull. Raffles Mus., no. 3, 1930, pp. 126, 127; Smedley, Bull. Raffles Mus., no. 5, p. 109; Parker, Monograph of the frogs of the family Microhylidae, 1934, p. 129; Bourret, Les Batraciens de l'Indochine, 1942, pp. 511-512.

*Diagnosis:* A small species, snout to vent, 20 mm.; a median groove on upper surface of digital discs; snout equal to or a little longer than eye; leg very long, tibiotarsal joint reaching beyond tip of snout; toes nearly three-fourths webbed; inner metatarsal tubercle, no outer; first finger less than half length of second.

*Description of species:* Snout rounded, its length equal or little longer than orbit; canthus rostralis obtuse; loreal region vertical or nearly so, not concave; width of upper eyelid contained in inter-orbital width 1.75 times; tympanum concealed; digits with widened discs, their upper surface bearing a median groove; inner finger very short, about half length of second; toes nearly two-thirds webbed, membrane midway between third and fourth, reaching level of distal tubercle on third toe, which is longer than fifth; an oval inner but no outer metatarsal tubercle; subarticular tubercles moderately large; tibiotarsal articulation reaching well beyond tip of snout; skin smooth both above and below.

*Color:* "Brown above, with an oblique black bar from above shoulder, along flanks towards groin; a light streak, sometimes black-bordered posteriorly, from below eye to fore-limb; a symmetrical dark marking on back commencing between eyes where it connects upper eyelids, narrowing behind occiput, widening between shoulders, narrowing again and then becoming indistinct; an oblique dark cross-bar on femur, tibia, and tarsus; a black spot on anterior aspect of knee and another in region of vent; head, from level of center of eyes to tip of snout may be green, with a triangular black spot on lip in front of eye. Lower surfaces lighter, closely marbled with brown" (after Parker, 1934).

*Measurement in mm.:* Snout to vent, 20.

*Variation:* Males have an ample vocal sac.

*Distribution:* The species has been reported by M. Smith as occurring at "Patiyu just north of the Isthmus of Kra" now Chumphon province. I am not aware of its having been collected elsewhere in Thailand.

Outside of Thailand the species has been taken in Malaya (Larut Hills, Perak, and Selangor).



*Microhyla annamensis* M. Smith

FIG. 89

*Microhyla annamensis* M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 6, no. 1, 1923, pl. 5, fig. 2 (type locality, Sui Kat, 1000 meters altitude, Langbian Plateau, S. Annam.); Parker, Ann. Mag. Nat. Hist., ser. 10, vol. 2, 1928, p. 483; Monograph of the frogs of the Family Microhylidae, 1934, p. 130.

*Diagnosis:* Body moderately slender; tympanum not visible; interorbital space wider than upper eyelid; digital discs relatively large, with median cleft; toes three-fourths webbed; small inner metatarsal tubercle; no outer tubercle; tibiotarsal articulation to tip of snout.

*Description of species* (after type description): Habit moderately slender, snout obtuse, little longer than eye; interorbital space broader than upper eyelid; fingers moderately long, with well-developed discs except first which is extremely short with blunt tip; second finger half length of third; toes with discs larger than those of fingers, digits three-fourths webbed; two phalanges of fourth toe free; upper surface of discs of digits with median cleft; feeble inner metatarsal tubercle, no outer; tibiotarsal articulation reaches tip of snout; tibia more than half length of head and body. Skin



FIG. 89. *Microhyla annamensis* M. Smith. From M. Smith, 1923, pl. 5, fig. 2, about natural size. Langbian plateau, Annam.

with numerous pustules and tubercles on dorsal surface; ventral surfaces smooth except for patch of granules below vent.

*Color:* Grayish above, with large dark angular blotch in middle of back; black spot above arm, and one above groin; dark cross-bars on limbs; below whitish, thickly speckled with gray.

*Measurement in mm.:* Snout to vent, 20; arm, 11.5; leg, 34.

*Variation:* The tibiotarsal articulation may reach beyond the tip of the snout, in some males, considerably beyond the tip. The webbing on the toes may be less than in the type. The warty pustular condition of the skin is always present in some degree. The dark dorsal blotch may have a faint white edge. The male has a subgular vocal sac and is smaller than the female.

*Remarks:* The species was caught on swampy ground among dense undergrowth. Many females are full of ripe pigmented eggs.

On the basis of the webbing it is most closely allied to *M. berdmorei* Blyth, the two having more webbing than other members of the genus. It differs, however, in less webbing, and the absence of an outer metatarsal tubercle. The discs of the fingers are larger, the skin more warty, the size smaller, and the coloration different. The type is a female.

*Distribution:* Known from Khao Seab in Thailand; and from the type locality on the Langbian Plateau, south Annam.

### *Microhyla inornata inornata* Boulenger

FIG. 90

*Microhyla inornata* Boulenger, Proc. Zool. Soc. London, 1890, p. 37 (type locality, Deli, Sumatra); Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, p. 342; Boettger, Zool. Anz., 1893, p. 430; Flower, Proc. Zool. Soc. London, 1899, p. 905; Laidlaw, Proc. Zool. Soc. London, 1900, p. 887; Werner, Zool. Jahrb., Syst., vol. 13, 1900, p. 502; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1904, p. 388; van Kampen, Zool. Jahrb., Syst., vol. 12, 1905, p. 713; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 259; M. Smith, Journ. Nat. Hist., Soc. Siam, vol. 2, 1916, p. 109; van Kampen, Amphibians of the Indo-Australian Archipelago, 1923, p. 153; M. Smith, Rec. Ind. Mus., vol. 26, 1924, p. 141; Nieden, Das Tierreich, Lief. 49, Anura II, Engystomidae, 1926, p. 33; M. Smith, Bull. Raffles Mus., no. 3, April 1930, p. 129; Parker, Ann. Mag. Nat. Hist., ser. 10, vol. 2, 1928, p. 498; A monograph of the frogs of the Family Microhylidae, 1934, pp. 144-145 (synonymy).

*Microhyla stinegeri* (sic) Boulenger, Ann. Mag. Nat. Hist., ser. 8, vol. 4, p. 494 (type locality, Kanchirei, Formosa).

*Microhyla stejnegeri* Stejneger, Proc. U. S. Nat. Mus., vol. 38, 1910, p. 92, 95; Nieden, Das Tierreich, Lief. 49, Anura II, Engystomatidae, 1926, p. 935.

*Diagnosis:* Small species (to 31 mm. ♀); snout shorter than orbit; first finger shorter than second; tympanum more or less distinct; toes entirely free, tips with very small discs; a single metatarsal tu-

bercle; male with an internal vocal sac; body grey or brown above spotted or marbled with black; heel to near back of eye; three metacarpal tubercles, inner very small, median almost directly in front of outer which occupies position farther back than in other species; strong supernumerary tubercles on palm; skin smooth everywhere save for some dim granulation indicated above vent.

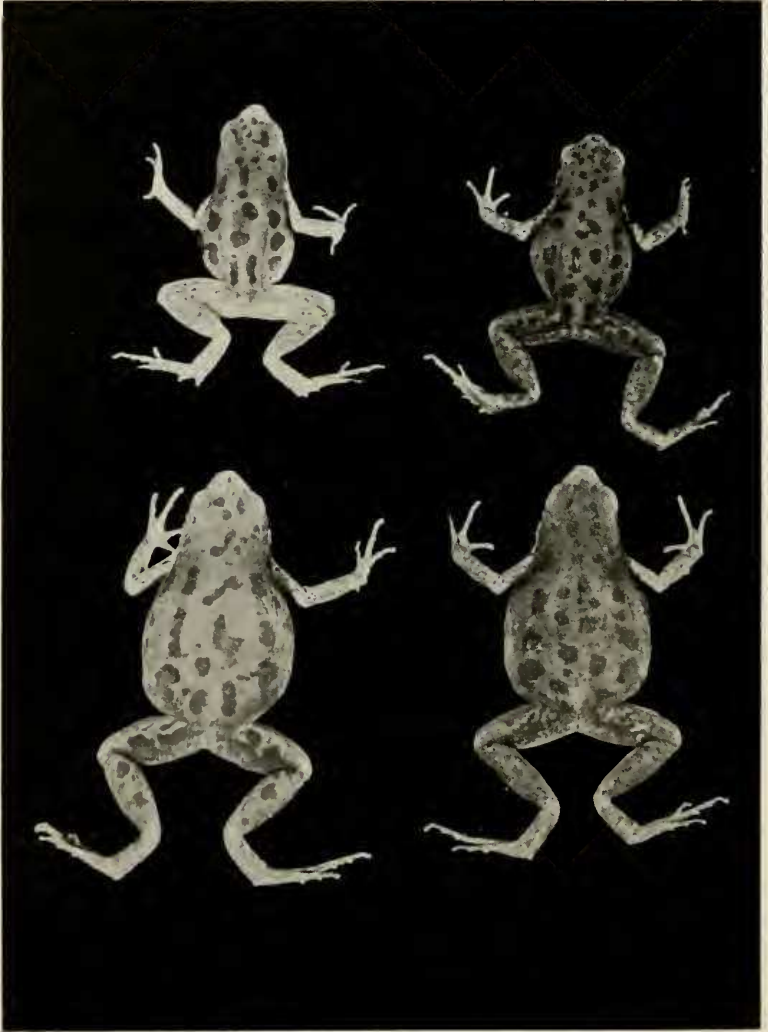


FIG. 90.—*Microhyla inornata inornata* Boulenger. Upper figures, males. Snout-vent length, *circa*, 23 mm. Lower figures, females. Length, *circa*, 30 mm. All from Chiang Mai, Chiang Mai, Thailand.

*Description of species* (from No. 1017 ♀, Chalermnarong, Chon Buri): Head and body rather flattened, loreal area almost vertical, not concave; canthus rostralis not, or but scarcely indicated; length of snout equal or slightly shorter than eye length; snout rounded in lateral profile, extending one millimeter beyond mouth; tympanum covered with skin, only upper edge overhung by fold beginning behind eye curving back to front of arm, separated from eye by distance equal to half its diameter; choanae rather large, half concealed when viewed from below; tongue free for about half its length, free on sides; males with an internal vocal sac opening through elongated slits into mouth.

Arms moderate, fingers with very small swollen discs, first finger much shorter than second (but considerably longer than distance to first subarticular tubercle of second); subarticular tubercles large; supernumerary tubercles on hand; metacarpal tubercles three, inner very small, median also small standing in advance of large outer; no lateral ridges on digits; legs short, toes entirely free with a slight ridge indicated on inner side of fourth toe; a single small inner metatarsal tubercle; no outer tubercle; tendon forming elevation on both ends of tarsus; subarticular tubercles well developed, smaller than those on hands; no supernumerary tubercles on sole; tibiotarsal articulation to back of tympanum; when legs are folded at right angles to body, heels touch or barely overlap.

Skin everywhere smooth (gravid female distended with eggs): the fold from eye rather dim.

*Color in life:* Gray-olive with deep black spots beginning on frontal region and scattered irregularly on back and sides; some spots on sides contiguous or fused; body becoming lighter low on sides; arms and legs light fawn with small scattered spots rather than bars; venter whitish cream with a peppering of pigment, enclosing small rounded pigmentless areas except on posterior part which is immaculate; some pigment on undersides of hands and feet; side of head with grayish reticulum enclosing small light spots or flecks.

*Measurements in mm.* (No. 1017 ♀ and No. 1019 ♂): Snout to vent, 25.5, 21; width of head, 8.1, 7.2; length of head, 7.5, 6.9; length of snout, 2.8, 2.3; length of eye, 3, 2.7; arm, 17, 15; leg, 36.2, 30; tibia, 11, 9.2; foot and tarsus, 16, 14.8.

*Variation:* Males and spent females show small pustules on the back and somewhat larger ones on the sides. Certain of the specimens are almost devoid of black spots. In these, the side of head

and body are darker and the light spots on the side of the head and on lips are discrete, usually yellowish-cream in color. Often, too, there are yellow spots low on the sides.

In the southern part of Thailand the population that seemingly belongs to this species presents an appearance so different as regards marking that I propose to distinguish it as a subspecies: The markings are arranged longitudinally forming continuous or broken lines.

*Distribution:* The spotted form is known from Chiang Mai (city), from low elevation on Doi Suthep, and Chalermmlarb, Chon Buri.

*Microhyla inornata lineata* subsp. nov.

FIG. 91

*Type:* No. 35534 ♀, 10 km. west of Nakhon Si Thammarat, collected by Edward H. Taylor, April 30, 1958.

*Paratypes:* Nos. 445, 35822, Khao Chong, Trang; 34793-94, Na Pradoo, Pattani; 35531-35533, 35535, topotypes (all same collector).

*Diagnosis:* Spots elongate arranged in lines on back; more or less distinct continuous stripe from tip of snout to above shoulder (often

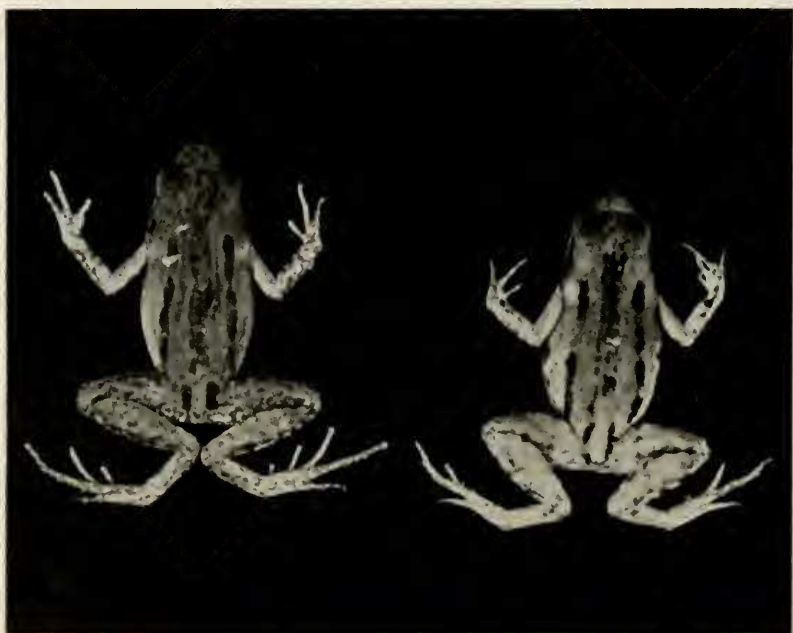


FIG. 91.—*Microhyla inornata lineata* subsp. nov. Right figure, type. No. 35534 ♀. Actual snout-vent length, 19.2 mm. Left figure, paratype. No. 35531 ♂. Length, 20 mm. 10 km. W Nakhon Si Thammarat, Thailand.



continued to groin); spots on lip tend to form a continuous irregular white line, and this may be continued across neck as a series of whitish spots; broken dorsolateral line.

*Description of type:* Body rather flattened; no canthus rostralis; snout depressed between nostrils, directed somewhat downward to tip, extending beyond mouth .8 millimeter; loreal region vertical, slightly concave behind nostril; snout distinctly shorter than eye-length; tympanum covered with skin but distinctly outlined; fold from eye across upper edge of tympanum to arm; choanae seen from below almost completely visible; tongue free behind for at least half its length, also free on sides.

Arm short; digits slightly swollen at tips, first much shorter than second; three metacarpal tubercles, inner small, outer placed almost directly behind median; supernumerary and subarticular tubercles well developed; leg with tibiotarsal articulation reaching eye; toes entirely free; an inner metatarsal tubercle, no outer tubercle.

Skin smooth, fold from eye to arm scarcely discernible.

*Color in life:* Brownish gray on dorsum; limbs light tan to fawn above; black stripe of irregular width from tip of snout along side of head to near groin, narrowed posteriorly; below this on side of head a cream stripe of irregular width from tip of snout to arm where it tends to cross breast as a series of light indistinct spots; below lateral stripe an indefinite light stripe; dorsolateral stripe from shoulder to groin; median stripe beginning on eyes as two lines that extend back diagonally and coalesce on median line; widening, it continues as moderately distinct line to back of lumbar area; two strong black marks at extreme end of rump; dark flecks and reticulation on posterior face of arms and front face of thigh and tibia; few flecks on dorsal part of limbs; chin and lower lip with numerous cream spots enclosed in reticulum of darker; scattering of pigment on breast and underside of thigh; most of ventral surface immaculate.

*Variation:* It will be noted that No. 34793 has short legs. It would appear that these specimens average smaller than the spotted forms of *inornata inornata* which occurs in the north. No. 34794, a gravid female, is the largest specimen seen; while several females of the spotted form are 30 or 31 mm. in length.

*Distribution:* Specimens are at hand from Pattani, Trang and Nakhon Si Thammarat.

Measurements in mm. of *Microhyla l. lineata*

Numbers.....	35534	34794	35535	34793
Sex.....	♀	♀	♂	♂
Snout to vent.....	19.2	22	19	19.2
Width of head at tympanum.....	6.25	7	7.1	6.1
Length of head.....	5.3	6.7	6.2	6
Eye.....	2.35	2.35	2.25	2.2
Snout.....	2	2.15	2	1.9
Arm.....	13	13.2	13	12
Leg.....	30	29.2	30	25
Tibia.....	9	8	9	7.2
Foot and tarsus.....	15	14	14	9

*Microhyla pulchra* (Hallowell)

FIG. 92

*Euglostoma pulchrum* Hallowell, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 506 (type locality "Between Hong Kong and Whampoa").

*Diplopetra pulchrum* Günther, The reptiles of British India, 1864, p. 417; Steindachner, Reise . . . Novara, Amphibia, 1867, p. 36, pl. 2, figs. 15-18; Tirant, Notes sur les reptiles et les batraciens de la Cochinchine et du Cambodge, 1885, p. 96.

*Microhyla pulchra* Boulenger, Catalogue of the Batrachia Salientia . . . in the collections of the British Museum, 2nd Ed. 1882, p. 165; Boettger, Ber. Offen. Ver. Nat., 1885, p. 50; Flower, Proc. Zool. Soc. London, 1899, p. 905; Werner, Abh. Bayer. Akad. Wiss., ser. 2, vol. 22, 2, 1903, p. 370; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, p. 39; *ibid.*, vol. 6, no. 2, 1923, p. 211; Parker, Ann. Mag. Nat. Hist., ser. 9, vol. 15, 1925, pp. 301, 304; Nieden, Das Tierreich, Lief. 49, Amura II, 1926, p. 31, fig. (synonymy); Pope, Bull. Amer. Mus. Nat. Hist., vol. 61, 1931, p. 599, fig. 39; Parker, A monograph of the frogs of the Family Microhylidae, 1934, pp. 137-138 (extensive synonymy).

*Microhyla hainensis* Barbour, Bull. Mus. Comp. Zool. Harvard College, vol. 51, 1908, p. 322 (type locality Mt. Wuchi, Central Hainan).

*Microhyla melli* Vogt, Sitzb. Ges. Naturf. Fr. Berlin, 1914, p. 101 (type locality "environs of Canton").

*Microhyla boulengeri* (*non* Vogt), Mell, Arch. Naturg., vol. 88, 1922, p. 130.

*Microhyla major* Ahl, Sitzb. Ges. Naturf. Fr. Berlin, 1930, p. 317 (type locality, Yao-Shan Mts. Kwangsi [1500 m.] China).

**Diagnosis:** A moderately large *Microhyla*; snout short and approximately equal to length of eye; first finger very much shorter than second; toes one-third to one-half webbed; tibiotarsal joint reaches to tip of snout, or slightly less; length of eye about equal to snout length; tips of digits not dilated, and without median cleft above; two very large metacarpal tubercles; strong inner metatarsal tubercle; small outer tubercle; when legs are folded at right angles to body, heels overlap.

**Description of species** (from No. 36287, Kaeng Pang Tao, 65 km.



FIG. 92.—*Microhyla pulchra* (Hallowell). Upper figure, No. 36260 ♀. Actual snout-vent length, 29 mm. Lower figure, No. 36257 ♀. Snout-vent length, 30 mm. Both from Kaeng Pang Tao, Chiang Mai, Thailand.

N. Chiang Mai, Thailand): Body subtriangular in shape, snout rather acuminate, short, about equal to length of eye; interorbital space distinctly wider than an eyelid; canthus rostralis absent, loreal region slightly oblique, area not concave; tympanum hidden; a postorbital fold more or less distinct; tongue narrow, oval, free behind for about two fifths of its length; no vomerine teeth; seen directly from below choanae partly concealed by maxillary shelf; palatal glands open in two groups of four pores in front of choanae; internal vocal sac with pair of elongate vocal slits lateral to tongue.

Arm weak; a pair of strong metacarpal tubercles; subarticular tubercles strong; first finger very much smaller than second; toes one-third to one-half webbed; digital tips not wider than digits; pair of metatarsal tubercles, outer relatively large; no tarsal fold; when legs are folded at right angles, heels overlap five millimeters or more; tibiotarsal articulation reaches little beyond tip of snout.

Skin of front part of head smooth; slight fold crosses head behind orbits; fold indicated behind eye bending down and continuing to near arm-insertion; back with numerous smaller and larger flat tubercles, only a few on limbs; skin of chin finely wrinkled; venter nearly smooth, with some indication of ventral disc; area below vent transversely wrinkled.

*Color:* Above varicolored; black band across interorbital area; behind this two broad light diagonal bands diverge and continue to groin; a  $\Delta$ -shaped mark on dorsum its apex between scapulae, its extremities in groin; dark canthal stripe; limbs with numerous wider and narrower bands, somewhat irregular; chin and chest more or less mottled with brown. In diagonal lateral areas fine parallel darker lines; black spots or more or less continuous black line extending along sides; groin, venter, and underside of limbs bright yellow. Chin black in male.

*Measurements in mm.:* Snout to vent, 29; axilla to groin, 11.5; width of head, 11.4; length of head, 8.7; arm, 14; leg, 49; tibia, 18; foot and tarsus, 21.

*Distribution:* The species has been taken in the following Thai provinces: Chiang Mai, Sara Buri, Nakhon Nayok, Phrae, Krabi, Chumphon, Nakhon Si Thammarat, and Chon Buri.

Outside of Thailand the species is known from Hongkong, China, Hainan, Tonkin, Cambodia and Viet Nam.

*Remarks:* I found this species breeding at Chalermklarb, Chon Buri, April 23, 1959.

One peculiarity in their calling is that the male population seem

to start calling at the same instant, and they likewise all seem to cease calling on the same note. The signal to begin is given usually by a single individual.

This is, I believe, the handsomest species of the genus.

*Microhyla ornata* Duméril and Bibron

FIG. 93

*Engystoma ornatum* Duméril and Bibron, *Erpétologie Générale* . . . vol. 8, 1841, p. 745 (type locality "côte Malabar").

*Diplopelma ornatum* Günther, *The reptilia of British India*, 1864, p. 417.

*Microhyla ornata* Boulenger, *Catalogue of the Batrachia Salientia s. Batrachia Ecaudata in the British Museum*, 1882, p. 165; *The fauna of British India, Ceylon and Burma; Reptilia and Batrachia*, 1890, p. 491; Flower, *Proc. Zool. Soc. London*, 1899, p. 901, pl. 60, fig. 1; Laidlaw, *Proc. Zool. Soc. London*, 1900, p. 887; Butler, *Journ. Bombay Nat. Hist. Soc.*, vol. 15, part 3, 15th Feb. 1904, pp. 387-388 (Penang, Kedah, Kelantan); Boettger, *Ber. Off. Ver. Nat.*, 1892, pp. 98, 102; M. Smith, *Journ. Nat. Hist. Soc. Siam*, vol. 2, no. 1, June 1916, p. 38, *ibid.*, vol. 2, no. 4, Dec. 1916, p. 169 (Maprit, Klong Bang Lai, Prachuap Khiri Khan); *ibid.*, no. 3, May 1917, p. 230; *ibid.*, vol. 2, no. 4, Dec. 1917, pp. 264-268; Parker, *Ann. Mag. Nat. Hist.*, ser. 10, vol. 2, 1928, p. 493; M. Smith, *Bull. Raffles Mus.*, no. 3, Apr. 1930, p. 129; Parker, *A monograph of the frogs of the Microhylidae*, 1934, pp. 139-141. (Extensive literature list and synonymy).

*Microhyla fissipes* Boulenger, *Ann. Mag. Nat. Hist.*, ser. 5, vol. 13, 1884, p. 397 (type locality, Taiwan-fu, S. Formosa); Stejneger, *Proc. U. S. Nat. Mus.*, vol. 58, 1907, p. 88; Nieden, *Das Tierreich*, Lief. 49; Anura II, 1926, p. 35.

*Microhyla cremita* Barbour, *Occ. Papers Mus. Zool. Michigan*, no. 76, 1920, p. 3 (type locality, Nanking); Stejneger, *Proc. U. S. Nat. Mus.*, vol. 66, 1925, p. 11.

**Diagnosis:** A medium-sized species (28 mm. snout-to-vent length); tips of toes swollen, without discs; toes with only rudiment of web; two metatarsal tubercles; tibiotarsal articulation reaches side of neck, sometimes nearly to eye; three metacarpal tubercles, median usually smallest, inner and outer in contact behind median; fold on breast (in males); an area of flat irregular granules on back part of venter and in an area behind anal region. Male with vocal sac.

**Description of species** (from No. 36477 ♂ from Kaeng Pang Tao, Chiang Mai): Body not slender, but squat and generally triangular; tip of snout rounded, extending beyond mouth for 1.3 millimeters; no canthus rostralis, loreal region oblique, not concave; snout length greater than length of eye; interorbital space greater than width of upper eyelid; fold from behind eye extends across tympanic area and runs above arm-insertion; tympanum hidden; nostril lateral, directed outward.

Choanae viewed from below partially concealed by maxillary shelf; tongue free for half its length, and free on sides; vocal sac opens to mouth through two very elongate slits.





FIG. 93.—*Microhyla ornata* Duméril and Bibron. Showing variation in markings. Upper figures, *circa*, 24 mm. Lower figures, *circa*, 27 mm. All from Kaeng Pang Tao, Chiang Mai, Thailand.

Arm short, fingers somewhat swollen at tips; first finger about one-half length of second; subarticular tubercles strong; lateral ridges on fingers indicated on inner side; three metacarpal tubercles, median smallest, wedged between inner and outer which are touching each other behind median. Legs relatively short, tibiotarsal articulation reaches back of eye. Toes somewhat flattened, tips slightly swollen; tiny web rudiment continued as fringe or ridge on sides of digits, more distinct on inner sides; subarticular tubercles large; two metatarsal tubercles, outer on elevated area of tendon almost as large as inner; when legs are folded at right angles to body, heels overlap one or two millimeters.

Skin with numerous large tubercles or pustules on dorsum; indication of row back of eye to shoulder; largest above arm-insertion; trace of hair-fine median ridge (broken); femur and tibia with numerous pustules above and few on arm near insertion; fold across front of breast (very strong in breeding males); patch of flat irregular granules on back part of venter and similar area behind and below vent.

*Color:* Various shades of gray-brown, with symmetrical brownish figure beginning on occipital region widening on shoulders, and growing gradually wider on rump where it loses some of its definition; outer edges somewhat darker than middle; diagonal stripe bordering this more grayish and lighter than the figure; on this stripe faint suggestions of darker parallel lines; sides of head little darker behind eye; dark elongate spot widening above arm-insertion then narrowing and disappearing about midway on side; legs banded; chin and throat blackish (males); under arms dull whitish; venter and under thighs cream; stripe on tarsus and sole, dark.

Measurements in mm. of *Microhyla ornata*.

Number.....	36477	36412	36416	36407
Sex.....	♂	♂	♀	♀
Snout to vent.....	27	25	28	28
Width of head.....	9	9	9	9
Length of head.....	7.7	7.4	7.4	7.2
Snout length.....	3	3	3	3
Eye length.....	2.85	2.8	3	3
Arm.....	14	14	12.3	11.9
Leg.....	40	41.05	39	42
Tibia.....	12.2	13	13	13
Foot and tarsus.....	20.5	20	18.2	19

All from Kaeng Pang Tao, Chiang Mai.

*Variation:* The apparently shorter arm of gravid females is perhaps due to the presence of the ovarian eggs which distend the body, thus also removing most evidence of pustules on the skin of dorsum, and the granulation of the posterior part of the venter. A fold across the front of the breast is scarcely indicated. A few specimens show the lower part of the tympanum, and although covered with skin, nearly a third of it may be visible. There are no supernumerary tubercles present on the palm; rarely a specimen may show a trace of a tarsal fold continuous with the inner metatarsal tubercle.

Specimens are often red-brown or smoky gray. The lighter diagonal area outside of the dorsal figure may have a series of fine lines, sometimes conspicuous.

*Distribution:* I have found this species in Thailand more frequently than any other *Microhyla*. It was especially common in northern Chiang Mai at Kaeng Pang Tao; also at Nong Khai and along the banks of the Mekong river for a distance of 50 kilometers where collections were made at intervals. The species is known from the two provinces mentioned, and the following: Udon Thani, Sara Buri, Kanchanaburi, Nakhon Si Thammarat, Trang, and Chumphon. I suspect it occurs in all the provinces of Thailand.

Elsewhere it is known in India (including Kashmir), Ceylon, Southern China, Indo-China, Formosa, and Malaya.

### *Microhyla heymonsii* Vogt

FIG. 94

*Microhyla achatina* (part.) Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 261 (localities in Malaya); M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 196, p. 39, fig. (tadpole); *ibid.*, vol. 2, no. 2, Dec. 1916, p. 169 (Patiyu and Pattani); Robinson and Kloss, Journ. Federated Malay States Mus., vol. 5, 1915, p. 155 ("Koh Pennan," Thailand); Cochran, Proc. U. S. Nat. Mus., vol. 77, 1930, p. 6.

*Microhyla heymonsii* Vogt, Sitzber. Ges. Naturf. Fr., Berlin, 1911, p. 181 (type locality, Formosa); Parker, Ann. Mag. Nat. Hist., ser. 10, vol. 2, 1928, p. 487; Nieden, Das Tierreich, Lief. 49, Anura II, 1926, p. 32 (part.); M. Smith, Bull. Raffles Mus., no. 3, Apr. 1930, pp. 127-128; Pope, Bull. Amer. Mus. Nat. Hist., vol. 61, 1931, p. 593, fig. 38; Parker, Monograph on the Microhylidae, 1934, pp. 134-135.

*Microhyla fissipes* (non Boulenger) Boulenger, Ann. Mag. Nat. Hist., ser. 8, vol. 4, p. 495.

*Diagnosis:* A small microhylid (snout to vent, 22 mm.); body flattened nearly uniform gray or brown above, with usually a hair-fine median line and one or two very small median black spots on back; side of head and body with black band reaching to near groin; tympanum hidden; three large well-defined metacarpal tubercles, subequal in size, median wedged between inner and outer,



FIG. 94.—*Microhyla heymonsi* Vogt. No. 1031. Actual snout-vent length, 22 mm. Chalerm-larb, Siracha, Chon Buri, Thailand.

but extending farther forward; two metatarsal tubercles, outer larger; slight web remnant; tips of digits widened into small discs.

*Description of species* (from No. 1032, Chalerm-larb, Chon Buri): Head very small, flattened, snout rounded or bluntly pointed then directed obliquely backwards to mouth; canthus rostralis not indicated; loreal region oblique, perhaps slightly convex rather than concave; snout (2.7 mm.) little longer than length of eye (2.3 mm.); tympanum hidden; slight skin-fold from eye reaches arm-insertion; snout projecting .8 mm.; nostril closer to tip of snout than to eye.

Choanae nearly lateral, partially concealed when palate is viewed directly from below; palate strongly arched; tongue large, rounded behind, free for one fourth its length; (male with an internal vocal sac, vocal slits parallel to jaw, much elongated).

First finger very short, reaching to level of front of subarticular tubercle of second finger; three very prominent oval metacarpal tubercles, median little farther forward than others; tips of digits widened into small discs; subarticular tubercles well developed; supernumerary tubercles on palm; leg short, tibiotarsal articulation

reaching front of eye; when legs are folded at right angles to body, heels overlap three millimeters; toes rather flattened; trace of web between toes, continued along sides of digits as lateral ridges; tips widened into small discs; strong subarticular tubercles; two metatarsal tubercles, outer larger; tendon enlarged, forming elevations at both ends of tarsus; outer metatarsals bound together.

Skin smooth generally but under lens some fine corrugation may be seen posteriorly and on sides; trace of median ridge; skin-fold begins back of eye and curves down to lower level of arm; chin glassy smooth, venter wrinkled; part of back and undersurface of thighs and back part of venter, granular.

*Color in life:* Above light gray to dusky gray along central parts of dorsum; darker on top of head; faint median light line with two fine black spots in middle of back; dark stripe from tip of snout through eye to near groin, lower edge indefinite becoming gray; limbs with indistinct bands; black triangular anal spot; some fine black spots on back of thigh, on back of tibia, and a black line on back of tarsus; entire ventral surface yellowish-cream with fine peppering of pigment on chin and throat.

*Measurements in mm.* (Nos. 1032 ♀ and 1023 ♂): Snout to vent, 22, 18; width of head, 7, 6.4; length of head, 6.5, 5.9; eye length, 2.3, 2.1; snout, 2.6, 2.3; arm, 11.2, 9; leg, 36, 29.6; tibia, 12, 10.3; foot and tarsus, 18, 14.

*Variation:* The general color pattern is maintained but the color may have a decided reddish tinge or may be brownish; most specimens are gray. Males usually have the chin and sometimes both chin and throat blackish, at least in the breeding season. Often the median light line (cream, yellow, or light gray) may be bordered with equally fine dark lines. The black spots in middle of the back may partially coalesce leaving a whitish center. In most specimens the transverse bands or lines on limbs are more distinct than in the described specimen. In some specimens there is a dim V-shaped spot beginning on the eyes and meeting back of the occiput, which may join a dim cloudy area that divides into two long, posteriorly directed, parallel limbs. Traces of this can be discerned if specimens are submerged in clear liquids.

*Distribution:* The species has been taken in the following provinces: Chiang Mai (several localities); Udon Thani, Loei, Chon Buri, Bangkok (Phra Nakhon), Chumphon, Pattani, Trang, and "Koh Pennan" (island). From these records one presumes that the species is distributed throughout the country.



The species was formerly confused with the Javan species *Microhyla achatina* and this accounts for the latter species having been reported from Thailand.

*Remarks:* While this is one of the smallest Microhylid species, it is one of the most easily recognized. It is very shy and difficult to capture. Both measured specimens are from Chalermklarb.

*Microhyla butleri* Boulenger

FIG. 95

*Microhyla butleri* Boulenger, Ann. Mag. Nat. Hist., ser. 7, vol. 6, 1900, p. 188 (type locality, Larut Hills, Perak, Malaya, 4000 ft.); Butler, Proc. Zool. Soc. London, 1902, p. 189; Journ. Bombay Nat. Hist. Soc., vol. 15, 1904 (second part of the article), pp. 388-389 (Larut Hills); Boulenger, Fasciculi Malayenses; Zoology, vol. 1, 1903, p. 172; Robinson, Journ. Federated Malay States Mus., vol. 1, 1905, p. 23; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 261; Vogt, Sitz. Ges. Nat. Berlin, 1913, p. 223 (Hainan); M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1917, p. 230 ("widely distributed" [in Thailand]); *ibid.*, vol. 4, no. 4, 1922, p. 214; *ibid.*, vol. 6, no. 2, Oct. 31, 1923, p. 212 (Hainan, Kiung-Chao and the "Hummocks"); Nieden, Das Tierreich, Lief. 49, Anura II, 1926, p. 31; Parker, Ann. Mag. Nat. Hist., ser. 10, vol. 2, 1928, p. 483; Cochran, Proc. U. S. Nat. Mus., vol. 77, 1930, p. 6 (Nong Khor, Siam); Gee and Boring, Peking, Nat. Hist. Bull., 4, 2, 1929-1930, pp. 26, 39; M. Smith, Bull. Raffles Mus., no. 3, 1930, pp. 126-127; Parker, A monograph of the frogs of the Family Microhylidae, 1934, pp. 131-132 (Siam localities, Ta Rua, Central Siam, Den Chai, N. Siam, Nong Khor, S. E. Siam; Maa Yome, N. of Prae; Paknam, Chumphon; and numerous Malayan localities; Hainan; Saigon; Szechwan, China); Bourret, Les Batraciens de l'Indochine, 1942, pp. 514-516, figs. 187-188.

*Microhyla boulengeri* Vogt. Sitz. Ges. Natur. Fr. Berlin, 1913, pp. 222, 227, 229 (type locality, Hainan).

*Microhyla latastii* Boulenger, Ann. Mag. Nat. Hist., ser. 9, vol. 6, 1920, p. 107 (type locality, Saigon).

*Microhyla hainanensis* (non Barbour) Mell, Arch. Naturg., vol. 88, 1922, 10, p. 131.

*Microhyla grahami* Stejneger, Occ. Papers Boston Soc. Nat. Hist., vol. 5, 1924, p. 119 (type locality, Sui-fu Sze-chwan, China).

*Microhyla sowerbyi* Stejneger, Occ. Papers Boston Soc. Nat. Hist., vol. 5, 1924, p. 119 (type locality, near Yenping-Fu, Fukien, China).

*Diagnosis:* A medium-sized species (26 mm.); tips of toes with distinct small discs bearing median notch and cleft on upper surface of disc; a peripheral groove; two metatarsal tubercles; toes about one-third webbed; dark mark on back usually distinct or broken into symmetrical spots, outer ones outlined in lighter color; usually light line from eye to arm-insertion with several more or less distinct glandules or glandular tubercles. A short tarsal fold following inner metatarsal tubercle.

*Description of speciés* (from EHT-HMS No. M.160 from Singapore Island): Body rather slender, snout rounded, as long as eye, extending .9 mm. beyond mouth; no canthus rostralis; snout rounded



FIG. 95.—*Microhyla butleri* Boulenger. EHT-HMS No. 162 (3337). Actual snout-vent length, 26 mm. Kuala Tahan, Malaya.

in lateral profile; loreal region oblique, not concave; tympanum hidden; fold from eye to level of arm; (in male a row of distinct glandules from eye follow groove to angle of jaw, scarcely distinguishable in female); interorbital distance a little greater than width of an upper eyelid; nostril equidistant from eye and tip of snout, directed nearly straight upward on dorsal part of snout.

Choanae viewed directly from below not hidden by palatal shelf; tongue long, free for two fifths of its length, as well as free on sides; vocal sacs opening into mouth through two very elongate slits; sides of throat (in males) with series of very fine diagonal longitudinal folds marking position of vocal sacs.

Limbs with digits widened into distinct discs, larger on toes than on fingers, each with peripheral groove (at least on toes) and on dorsal surface of disc, a forward notch followed by cleft; fingers with well-developed subarticular tubercles, no supernumerary tubercles; first finger reaches subarticular tubercle of second; three metacarpal tubercles, outer largest, narrow, more or less fused with median; toes about one-third webbed, flattened, with ridge or fringe on outer and inner edges extending to discs, which are larger than those on fingers; two metatarsal tubercles, both small, inner slightly elon-

gated, and followed by very short tarsal fold. The tendon of tarsus not conspicuously enlarged. When limbs are folded at right angles to body, heels overlap two millimeters; tibiotarsal articulation reaches to nostril. Skin smooth but with some rather large smooth flattened pustules on front part of dorsum; skin on sides of throat finely plicate; venter, breast, chin, and underside of limbs smooth.

*Color:* Gray to brownish-gray on back; sides showing some lighter flecks (probably red in life); rather large, more or less symmetrical blackish mark on dorsal areas which is deep black often surrounded with a fine lighter line (cream or red in life); in life red or scarlet spots on sides; cream line from eye to arm-insertion and light area on tip of snout; whitish to cream below on venter, chin clouded with dusky (males) less so in females; some flecks along sides of venter; limbs irregularly barred with dark marks.

*Measurements in mm.* (EHT-HMS Nos. M. 160 ♂ -161 ♂, Singapore; No. 36604 ♀, Whey Tat, Chiang Dao, Chiang Mai, respectively): Snout to vent, 21.4, 23, 22.5; width of head, 7, 7.2, 7; length of head, 7, 7.1, 6.8; eye, 2.8, 2.7, 2.7; snout, 2.8, 2.8, 2.7; arm, 12, 12.5, 11.5; leg 36, 37, 34; tibia, 11.5, 12.2, 11.2; foot and tarsus, 17.2, 18, 17.2.

*Variation:* There is considerable difference in general appearance depending upon the intensity of the dark coloration. Sometimes part of the dorsal figure lacks definition, the emphasized portions appearing as distinct spots; occasionally the general outline is lost altogether and symmetrical spots result.

The specimen from Chiang Mai is typical of this latter coloration. Of the two Singapore specimens, one has the toes a little less than a third webbed. The slight tarsal fold may be easily overlooked unless sought with a lens.

*Distribution:* The species has been taken in the following provinces in Thailand: Chiang Mai, Loei (Phu Kading, 5000 ft. elev.), Phrae, Chumphon, and Chanthaburi.

Outside of Thailand the species is known in Malaya, Burma (south Shan States), Hainan, and Tonkin.

*Remarks:* The tadpoles are nearly transparent, and usually have some scarlet or reddish brown on the tail, according to Malcolm Smith.

Specimens I collected were ensconced under small bits of turf and leaves near a small pool at Phu Kading. The males were calling and the cry sounded like nothing so much as the gritting of human teeth!

*Microhyla berdmorei* (Blyth)

FIG. 96

- Engystoma berdmorei* Blyth, Journ. Asiat. Soc. Bengal, vol. 24, 1856, p. 720 (type locality, Pegu, Burma).
- Diplopetma berdmorei* Günther, Zool. Rec., 1868, p. 146; Proc. Zool. Soc. London, 1868, p. 479; Anderson, Proc. Zool. Soc. London, 1871, p. 202; Stoliczka, Proc. Asiat. Soc. Bengal, vol. 39, 1872, p. 109.
- Microhyla (Engystoma) berdmorei* Boulenger, in Mason's Burma, vol. 1, 1882, p. 500; Theobald, *idem.*, vol. 1, p. 292.
- Microhyla berdmorei* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum, 1882, p. 166; The fauna of British India, . . . Reptilia and Batrachia, 1890, p. 492; Slater, Proc. Zool. Soc. London, 1892, p. 348; Flower, *ibid.*, 1896, p. 908; *ibid.*, 1899, p. 906; Fea, Ann. Mus. Civ. Genova, ser. 2, vol. 17, 1897, p. 476; Laidlaw, Proc. Zool. Soc. London, 1900, p. 888; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1904; Boulenger, A vertebrate fauna of the Malay Peninsula . . . Reptilia and Batrachia, 1912, p. 263; Barbour, Mem. Mus. Comp. Zool. Harvard College, vol. 44, 1912, p. 173; M. Smith and Kloss, Journ. Nat. Hist. Soc. Siam, 1915, vol. 1, no. 3, p. 249 (Klong Yai, SE Thailand); M. Smith, *ibid.*, vol. 2, 1916, p. 169 (Maprit, Klong Bang Lai); van Kampen, The Amphibia of the Indo-Australian Archipelago, 1923, p. 158; Nieden, Das Tierreich, Lief. 49, Anura II, Engystomatidae, 1926, p. 33; Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, Mar. 20, 1958, pp. 1070-1072, fig. 11 (Loei province).
- Microhyla berdmorei* M. Smith, Rec. Ind. Mus., vol. 26, 1924, pp. 141-142, pl. 7, fig. 1 (Phan Rang, Annam); Parker, Ann. Mag. Nat. Hist., ser. 10, vol. 2, 1928, p. 479; M. Smith, Bull. Raffles Mus., no. 3, 1930, p. 127, fig. 13; Cochran, Proc. U. S. Nat. Mus., 1930, vol. 77, p. 7.
- Callula natatrix* Cope, Journ. Acad. Nat. Sci. Philadelphia, 1867, ser. 2, vol. 6, p. 199 (type locality, Rangoon, Burma).
- Microhyla fowleri* Taylor, Proc. Acad. Nat. Sci. Philadelphia, vol. 86, 1934, pp. 284-286, pl. 17, fig. 2, text fig. 1 (type locality, Chiang Mai, Thailand).
- Microhyla malcolmi* Cochran, Proc. Biol. Soc. Washington, vol. 40, 1927, p. 182 (type locality, "Pak Jong, Siam").

**Diagnosis:** Snout subacuminate, as long as orbit; first finger shorter than second; toes elongate, webbed to tips which are widened into broad discs, the upper surface of which are divided by a groove. Tibiotarsal joint to snout-tip or beyond; male with vocal sac; back usually with an hourglass-shaped spot (sometimes broken) often partly outlined in whitish. Outer and inner metatarsal tubercles; strong fold across neck in male.

**Description of species** (from No. 49, Doi Suthep, Chiang Mai): Head slender, snout acuminate; loreal region nearly vertical, not concave; interorbital width equal to width of an eyelid; tympanum indistinct, covered with skin; length of eye (3.5 mm.), shorter than snout, (5 mm.); tongue slender, rounded, free behind for one half or more of its length; palatal glands discharge through openings near upper anterior edge of choanae; vocal sac indicated externally by strong fold across breast; vocal sac present. Two vocal slits along sides of tongue; no vomerine teeth.



FIG. 96.—*Microhyla berdmorei* (Blyth). K. U. M. N. H. No. 40187 ♀. Actual snout-vent length, 39 mm. Phu Kading, 1045 m., Loei, Thailand.

Arms slender; tips of fingers widened into small discs, and with slight lateral ridges and a mere web-remnant. First finger much shorter than second (first finger abnormal on right hand); inner metacarpal tubercle rather large, outer tubercle larger, somewhat bifid; well-developed subarticular tubercles; toes webbed to widened terminal discs; distinct inner and small outer metatarsal tubercle; tibiotarsal articulation reaching beyond tip of snout; outer metatarsal united; when legs are folded at right angles to body, heels overlap five millimeters. Discs with median groove above, separating two swellings.

Skin above with smaller and larger tubercles, most strongly developed laterally; skin on throat somewhat wrinkled; venter and lower surface of thighs smooth or minutely wrinkled; some tubercular granulation below vent.



*Color:* Above grayish or brownish-gray, with a butterfly-shaped dark mark between eyes, extending to shoulders, narrowly joined to large somewhat indefinite spot on dorsum that extends back on rump, partially outlined with lighter edges; limbs with dim blackish bars. A few deep black spots on tarsus, foot, back side of tibia, and on forearm; front of femur with light diagonal band with very small vermiculations of darker color and some larger darker spots near knee; back of thigh similarly marked, and with deep black arch above vent; some blackish marks behind axilla; a diagonal light line from eye to arm-insertion. Web of front foot dark, blackish under tarsus; chin dark.

Measurements in mm. of *Microhyla berdmorei*

Number.....	49	40	51	52	14
Snout to vent.....	37	36	36.4	37.5	38
Axilla to groin.....	14	14	15	14	15
Width of head.....	17	16	16.2	16.3	17
Length of head.....	11.5	11.4	12	13.2	13.8
Arm.....	20	20	20	21.5	22
Leg.....	64	66	66	66	70
Tibia.....	23	24	24	23.5	25.3
Foot and tarsus.....	26	27.5	28	28	28.3

*Variation:* Specimens from the Chiang Mai region seem to show more tuberculation than more southern ones, some of which may be nearly smooth. The legs vary in length, since in some the heels overlap 10 millimeters. The dorsal pattern varies greatly in distinctness and detail. The type of *Microhyla malcolmi* has more webbing on the hand than most other specimens.

*Distribution:* The species is widely distributed in Thailand. Specimens are known from the following provinces: Chiang Mai (Doi Suthep), Phrae, Chon Buri, Loei (Phu Kading), Chanthaburi, Trad, Chumphon (Maprit), Nakhon Si Thammarat, Phatthalung, and Yala (Bhetong).

Outside of Thailand the species occurs in Pegu and Tenasserim in Burma; Annam, Malaya, and Sumatra.

*Remarks:* I collected a series of *Microhyla berdmorei* from a large rainpool on the side of Doi Suthep, Chiang Mai province (elevation, about 1000 ft.) at eleven o'clock in the morning of September 12, 1959. I first heard the breeding chorus from a point more than a quarter-mile away. The pool had filled early the previous evening during a heavy rain. I do not know when the chorus

began but at this time it seemed unabated, and was continued at least until late afternoon when I left the vicinity. A number of pairs of frogs were seen clasping and the surface showed many groups of floating eggs spread about on the surface; but the pairs seemed remarkably wary, diving and escaping. No females were taken.

Most of the eggs were centered about bits of grass, floating chips, or twigs emerging from the water.

Only one other species frog was heard calling, presumably a single male specimen of *Rana pileata*.

### Genus *KALOULA* Gray

*Kaloula* Gray, Zoological Miscellany, 1831, p. 38 (type of genus *Kaloula pulchra*).

Palatine bones forming a ridge across palate; no precoracoids, no omosternum, sternum cartilaginous; diapophyses of sacrum moderately dilated. Pupil round, tongue entire or nicked behind; two dermal ridges across palate in front of esophagus; tympanum hidden. Fingers free, toes more or less webbed; tips of digits pointed or, more or less dilated. Outer metatarsals united.

Two species occur in Thailand, the common, *Kaloula p. pulchra*, and the rare, *K. mediolineata*.

#### KEY TO SPECIES OF *KALOULA* IN THAILAND

1. Digits distinctly widened at tips, truncate, slight web at base of toes,  
*Kaloula p. pulchra*
- Digits pointed at tips, toes of adult more than half webbed,  
*Kaloula mediolineata*

### *Kaloula pulchra* Gray

This species has two or more subspecies of which the typical one is present in Thailand.

### *Kaloula pulchra pulchra* Gray

FIG. 97

*Kaloula pulchra* Gray, Zoological Miscellany, 1831, p. 38 (type locality "China"); Günther, Catalogue of the Batrachia Salientia . . . 1858, (1859), p. 123; The reptiles of British India, 1864, p. 437; Steindachner, Reise der Österreichischen Fregatte Novara . . . Amphibien, pp. 68-69 (Ceylon); Cochran, Proc. U. S. Nat. Mus., vol. 77, pp. 7-8.

*Callula pulchra* Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 1882, p. 170; The fauna of British India . . . Reptilia and Batrachia, 1890, p. 494; Flower, Proc. Zool. Soc. London, 1896, p. 908; *ibid.*, 1899, p. 906; Laidlaw, *ibid.*, 1900, p. 888; Butler, Journ. Bombay Nat. Hist. Soc., vol. 15, 1904, p. 390; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 1, June 1916, pp. 40-42, pl., figs. B 1, 2, 3; *ibid.*, vol. 3, no. 3, May 1917, p. 230; Annandale, Mem. Asiat. Soc. Bengal,

vol. 6, 1917, p. 152, fig.; Nieden, *Das Tierreich*, Lief. 49, Anura II, 1926, p. 22, fig.; M. Smith, *Bull. Raffles Mus.*, no. 3, Apr. 1930, p. 121, fig. 10.  
*Hylaedactylus bivittatus* Cantor, *Journ. Asiat. Soc. Bengal*, vol. 16, 1847, p. 1064.

*Kaloula pulchra pulchra* Bourret, *Les Batraciens de l'Indochine*, 1942, pp. 487-490, fig. 175-176 (good literature list).

*Diagnosis*: Digits widened, especially at tip, and truncate; entire dorsum brown with two dark-edged light brown, yellowish, or pink stripes from eye to groin. No median stripe; web remnant on toes.

*Description of species* (from No. 1091 ♀, Chon Buri): Body subtriangular in shape with limbs involved in body skin leaving less than a third of femora free; canthus rostralis scarcely indicated; loreal region sloping obliquely, not concave; nostril nearer tip of snout than to eye; width of interorbital area (8 mm.) much greater than width of an upper eyelid (5 mm.); tympanum concealed; faint fold across occiput from eye to point of arm-insertion; snout extends little (1.3 mm.) beyond mouth.

Choanae transversely widened, irregularly shaped, not concealed when palate is viewed from below; pair of transverse elevated ridges from outer level of choanae run behind them, but separated mesially by diastema; an elevated ridge anterior to outer part of choanae; fleshy fold arches across palate behind orbits preceding a straight transverse denticulate fold; tongue free for a little less than half its length; (males with an ample subgular vocal sac, opening through rather short vocal slits, partly covered by skin folds; a large external fold on chin marks vocal sac externally.

Arms rather long; fingers long, gradually widened at tips, terminally truncate and lacking peripheral groove, or transverse groove on wider portion; first finger shorter than second; subarticular tubercles very moderate; three metacarpal tubercles, outer longest, median smallest; no supernumerary tubercles on palm.

Leg very short, foot slightly longer than hand; toes much narrower than fingers, tips slightly swollen but not widened, with web remnant; subarticular tubercles distinct; fifth toe shorter than second and not extending as far forward; two metatarsal tubercles, inner shovel-shaped with free edge; outer smaller, rounded, separated from inner; no tarsal fold; tibiotarsal articulation reaching to point above arm-insertion; when legs are folded at right angles to body, heels separated by distance of 10 millimeters.

Skin finely granular with some scattered pustular tubercles; skin of chin, sides, venter, and underside of thigh granulate, granules or areolae small, irregular, usually not rounded, but angulate.

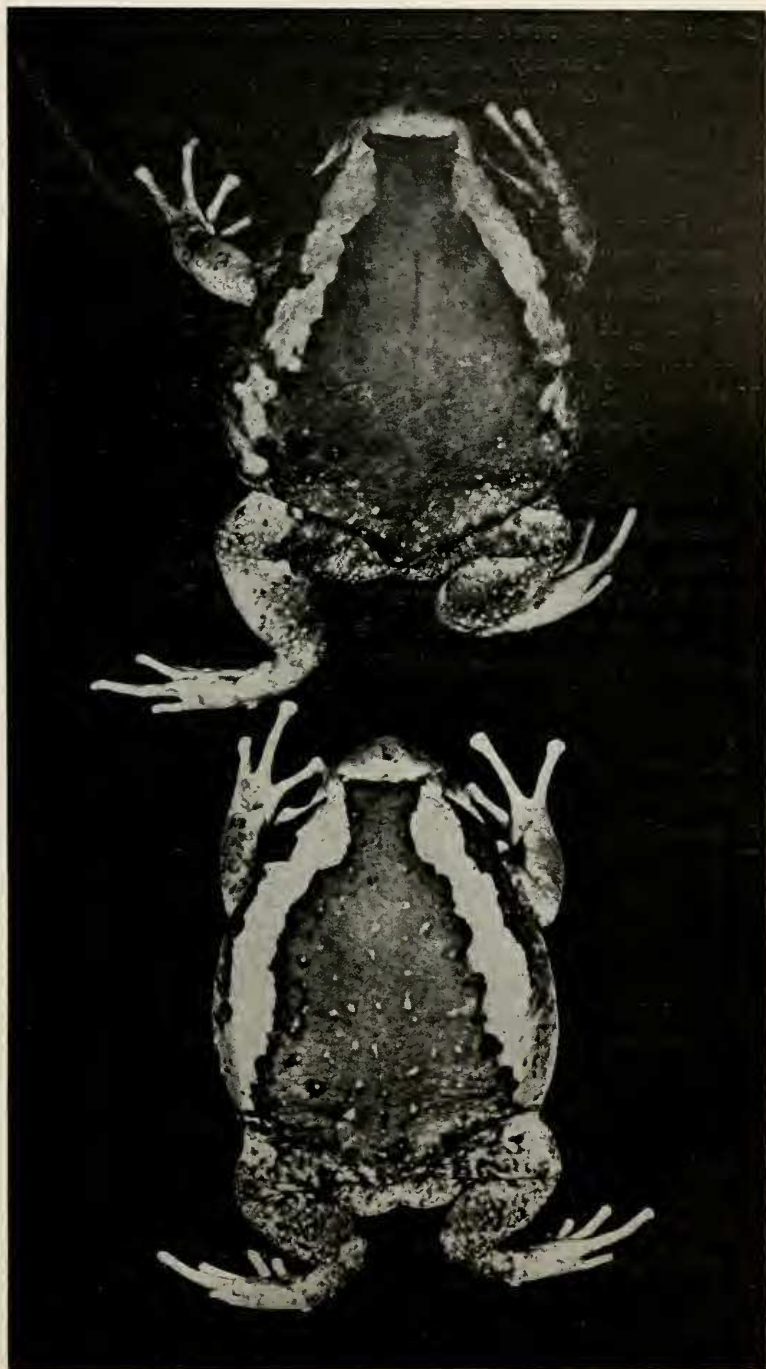


FIG. 97.—*Kaloula pulchra pulchra* Gray. Upper figure, No. 1091 ♀. Actual snout-vent length, 70 mm. Lower figure, No. 1106 ♂. Length, 65 mm. Both from Chalermnarb, Chon Buri, Thailand.

*Color:* A large mark beginning in interorbital region extends back, with sides nearly parallel on occiput; it begins widening on shoulders and continues to posterior edge of body. An irregular-edged light brown diagonal stripe from eye to groin, bordered below by a dark irregular-edged stripe; an interrupted light band crosses femur and tibia, which are indefinite black with some fine white flecks. Below smoky, darker under chin; venter reticulated with light smoky-lavender inclosing small lighter areas.

*Measurements in mm.* (No. 1091 ♀ and 1106 ♂): Snout to vent, 70, 65; width of head, 25, 24; length of head, 15, 14; arm, 49, 44.2; leg, 86, 76; tibia, 26.2, 24; foot and tarsus, 39, 39.

*Variation:* The general pattern changes but little, but the shades of color vary greatly. No two specimens, seemingly, have the same exact color. The lateral stripes may be whitish, greenish, fawn, yellowish-orange, gray, brown, or pink.

*Distribution:* This species is widespread throughout the country in lowlands and probably occurs in every province in Thailand.

Outside of Thailand it is known in Malaya. In Ceylon and in part of India it is replaced by another subspecies.

*Remarks:* This narrow-mouthed toad has a very loud low-pitched voice that can be heard for a considerable distance. Since there are many hundreds of ponds or klongs in Bangkok, each apparently with at least a few individuals of this species, most, if not all, city dwellers are familiar with their noise and have had an opportunity of lying awake at night listening to their booming cries.

The toads inflate their bodies with air, fill the subgular vocal sac and float, spread out on the surface of the water.

### *Kaloula mediolineata* M. Smith

FIG. 98

*Callula mediolineata* M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, no. 3, May 1917, pp. 224-225, pl., fig. 2 (type locality, Prachuap Khiri Khan); *ibid.*, vol. 2, no. 3, May, 1917, p. 230 (Nong Pling, Central Siam, Ubon, Prachuap Khiri Khan); Parker, A monograph of the frogs of the family Microhylidae, 1934, pp. 81-82 (Paknambo, Korat, Ubon, Prachuap Khiri Khan); Bourret, Les Batraciens de l'Indochine, 1942, p. 485.

*Diagnosis:* Toes pointed, about half webbed. Dark above with broad light-yellow or light brownish marks from upper eyelid to groin; similar median stripe from middle of back to near vent; two large compressed metatarsal tubercles, outer smaller.

*Description of species:* Head elevated in occipital region, snout lower, short, rounded; no canthus rostralis, nostril closer to eye than





FIG. 98.—*Kaloula mediolineata* M. Smith, No. 34177. Actual snout-vent length, 56 mm. Ang Hin, Chon Buri, Thailand.

to median point on tip of snout; length of eye twice length of snout; interorbital distance distinctly wider than an eyelid; tympanum hidden; a fold from eye across tympanic area. A rather wide, somewhat denticulated ridge across palate in front of esophagus; this preceded by an arched dermal fold lying between orbits; choanae crowded between eyeballs and front of palate; tongue oval, slightly nicked posteriorly; tongue free behind, no vomerine teeth; large vocal slits connecting with subgular vocal sac.

Arms short, fingers free, with indistinct lateral ridges, first much shorter than second; three metacarpal tubercles, inner largest, median rounded and close to outer tubercle; four supernumerary tubercles present; subarticular tubercles rather small; two very large metatarsal tubercles, the inner shovel-shaped, outer smaller, thicker, narrowly separated from inner tubercle; subarticular tubercles small; no supernumerary tubercles visible. Tibiotarsal articulation fails to reach to arm-insertion; when femora are at right angles to body lateral skin reaches to knee. A distinct fold across breast; a slight axillary web; some indistinct granules on back; venter smooth.

*Color:* A narrow dark-brown line across eyelids; broad brown dark-edged stripe from head, widening posteriorly and bifurcating posteriorly; brown lateral stripe from eye to groin; light-brown stripe from eye terminating in groin, and similar stripe from vent to rump; one broad dark band across thigh and tibia; arm above light brown; chin (♂) blackish brown; entire venter yellowish white.

*Measurements in mm.:* Snout to vent, 56; width of head (tympanic region), 20; length of head, 17; arm, 32; leg, 61; tibia, 22; foot and tarsus, 31.5.

*Variation:* The species was described from young specimens, the largest being 38 mm. in length. It is probable that the females reach a length somewhat greater than that recorded for the male above (56 mm.).

The dorsolateral light stripe may be broken into elongate spots, and the light median stripe varies in length. In two young specimens, the median is barely indicated.

*Distribution:* This species, known only in Thailand, has been found in Korat, Ubon, "Nong Pling near Paknampo," Chon Buri (Ang Hin); and at the type locality, Prachuap Khiri Khan.

*Remarks:* Information regarding the life history of this species is greatly to be desired. It is to be found in or near the same pools with *Kaloula pulchra pulchra*, *Glyphoglossus molossus* and *Caluella*

*guttulata*. However, even after having been described for 45 years it is still comparatively unknown.

At Ang Hin where one adult and two young have been taken, dozens of *Kaloula pulchra pulchra* have been found. Their calls may be heard after almost every heavy rain during August and September. I have never detected the call of *mediolineata*.

### Genus CALLUELLA Stoliczka

*Calluella* Stoliczka, Proc. Asiat. Soc. Bengal, 1872, p. 146, figs. 3, 4 (types of genus *Megalophrys guttulata* Blyth); Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd Ed., 1882, p. 181.

*Dyscophina* van Kampen, Zool. Jahrb., Syst., vol. 22, 1905, p. 708 (type of genus *Dyscophina volzi*).

**Diagnosis:** Burrowing frogs, maxillary and vomerine teeth present; prevomer large, almost surrounding choana, in contact with its fellow mesially, ankylosed to palatine and bearing teeth; clavicles and procoracoids present; sternum cartilaginous, large; terminal phalanges simple. Pupil of eye circular. Tongue large, oval, entire, and somewhat free behind. Two dermal ridges across palate. Tips of digits slightly widened, toes webbed.

Three species are recognized; one is from Sumatra, one from Yunnan; a single species enters Thailand and Burma.

### *Calluella guttulata* (Blyth)

FIG. 99

*Megalophrys guttulata* Blyth, Journ., Asiat. Soc. Bengal, 1855, vol. 24, p. 717 (type locality, Pegu, Burma).

*Callula guttulata* Günther, Proc. Zool. Soc. London, 1868, pp. 479, 490, pl. 40, fig. 1.

*Calluella guttulata* Stoliczka, Proc. Asiat. Soc. Bengal, 1872, p. 146; Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd Ed., 1882, p. 181; The fauna of British India . . . Reptilia and Batrachia, 1890, p. 498; Ann. Mus. Civ. Genova, ser. 2, vol. 13, 1893, p. 348 (in separate p. 7); Fea, Ann. Mus. Civ. Genova, ser. 2, vol. 17, 1897, p. 476; Boulenger, Ann. Mag. Nat. Hist., ser. 7, vol. 13, 1904, p. 44; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1917, pp. 225, 230 (widely distributed in Siam in suitable places); Nieden Das Tierreich, Lief. 49, Anura II, 1923, p. 8; Bourret, La faune de l'Indochine, Vertébrés, 1927, p. 262; Cochran, Proc. Zool. Soc., Washington, vol. 77, 1930, p. 8; M. Smith, Bull. Raffles Mus., no. 3, 1930, pp. 119-120, fig. 9; Parker, A monograph of the frogs of the Family Microhylidae, 1934, pp. 28-29, fig. 3 (numerous Thai records); Bourret, Les Batraciens de l'Indochine, 1942, pp. 481-482, figs. 172, 173.

**Diagnosis:** Maxillary teeth present; transverse rows of vomerine teeth; tympanum hidden; choanae far forward on palate. Digits bluntly pointed.

**Description of species** (from No. 1007 ♀, Chalermklarb, Chon



FIG. 99.—*Calluella guttulata* (Blyth). No. 33728 ♂. Actual snout-vent length, 40 mm. Doi Suthep, Chiang Mai, Thailand.

Buri): Body roughly triangular in shape; snout rather rounded, extremely short (3.35 mm.), less than length of eye (4.2 mm.); no canthus rostralis; loreal region oblique, not concave; nostril nearer tip of snout than to eye; interorbital width (4.5 mm.), much wider than an upper eyelid (3.1 mm.); tympanum not visible. A fold from eye runs diagonally across tympanic region terminating above arm.

Choanae against front of palate, partially visible when viewed directly from below; vomerine teeth on two straight transverse

ridges, originating behind choanae and beyond their outer edges, separated by a short mesial diastema; tongue wide and thick anteriorly, narrower and slightly nicked posteriorly, free for half its length; (male with a large subgular vocal sac opening into mouth through elongate lateral slits, covered more or less by fold of skin); curved thickened fold across palate behind orbits, and longer somewhat denticulated transverse fold or ridge behind it.

Arm short; digits completely free, bluntly pointed at tips; first finger shorter than second; subarticular tubercles moderately developed; three metacarpal tubercles, outer longest, median small somewhat in advance of other two; two or three small supernumerary tubercles on palm. Legs short, toes pointed, webbed at base for about one third of their length, webs continued distally as narrow fringes on each side of digits; subarticular tubercles moderate; large, somewhat shovellike inner metatarsal tubercle; small conical outer tubercle; tibiotarsal articulation reaches to level of angle of jaws; when legs are folded at right angles to body heels fail to touch by two or three millimeters.

Skin seen under lens minutely granulate with larger tubercles scattered on sides of neck and shoulders and on rump; tubercles evident on thigh and tibia; on head in interorbital area, two larger pustular tubercles, and on occiput a curving series of four, that may continue diagonally on sides with smaller pustules; pair of tubercles on shoulders that mark wide point on a dark figure; side of head rather corrugated with some glandules near mouth-angle; some tubercles on sides of chin; a slight transverse curving skin-fold in front of breast; venter and underside of thighs without tubercles or granules; few tubercles on sides of vent.

*Color in life:* Dorsal parts of body brownish with dark diagonal mark following supratympanic fold; dark marks begin on upper eyelids, extend back and meet mesially, then again diverge as far as two enlarged tubercles, then again converge behind these, the pattern indefinite; two rather definite spots in groin; transverse black mark on back of thighs, widening to include area about vent; this bordered anteriorly by a cream or fawn line; area about jaw-angle amber; inner fingers whitish; chin finely flecked and reticulated with brown; venter and undersides of thighs whitish; soles of feet dark lavender; indefinite marks on sides; limbs indefinitely barred with blackish.

*Measurements in mm.* (Nos. 1007 ♀, 1011 ♂, respectively): Snout to vent, 50, 43; width of head, 20, 19; length of head, 16, 13.5; arm, 28.5, 28; leg, 68, 62; tibia, 22, 19.5; foot and tarsus, 33, 30.



*Variation:* The skin of the anterior part of the venter on males is thickened and glandular, and the vocal sac is evidenced by heavy folds of skin.

The tongue in most specimens is rounded or somewhat truncate behind without a notch. A skinfold may be present across the head between the eyes. The choanae in males are more exposed than in females.

The details of the color pattern vary much. Many specimens have reddish blotches. The general color may be olive-gray, greenish or even yellowish, the dark spots on the back often being outlined in light reddish, whitish, or cream. The external surface of vocal sac of the male is deep black during the breeding season. The population in Thailand differs from that in Malaya, in having the inner metatarsal tubercle proportionally larger, and the webbing of the feet very distinctly less.

A review of the various populations of *Calluella guttulata* may point to the necessity of distinguishing these considerable variations as subspecies.

An adult gravid female from Kuala Tahan, Pahang, measures 38 mm. snout to vent, and a male from the same locality is 34 mm. This suggests a size difference in the populations.

*Distribution:* In Thailand the species has been taken in Bangkok and in the provinces of Chiang Mai, Chon Buri, and Chumphon. It appears to be a lowland species probably not reaching high elevations in the mountains.

Outside of Thailand, the species occurs in Burma (type locality, Pegu), and Malaya.

#### GENUS *KALOPHRYNUS* Tschudi

*Kalophrynus* Tschudi, Mem. Som. Sci. Neuchâtel, vol. 2, 1838, p. 86 (type of the genus *Kalophrynus pleurostigma*).

"Prevomer divided, the postchoanal portion absent; palatine absent; ethmoids minute or absent. Clavicles and procoracoids present, well developed, reaching the mid-line of the girdle and scapulae; omosternum small, cartilaginous; sternum large cartilaginous. Vertebral column diplasiocoelous. Terminal phalanges T-shaped.

"Pupil horizontal; tongue oval or subcircular, entire and half free behind. A strongly denticulated ridge across the palate in front of the pharynx, preceded by a shorter, curved, nearly smooth one; a smooth ridge behind each choanae; digits not dilated distally; skin thick and glandular." Parker, 1934.

*Kalophrynus pleurostigma pleurostigma* Tschudi

FIG. 100

*Kalophrynus pleurostigma* Tschudi, Mem. Soc. Sci. Neuchâtel, vol. 2, 1838, p. 86 (type locality, Sumatra); Günther, Catalogue of the Batrachia Salientia in the collection of the British Museum, 1858 (1859), p. 54; Smith, Bull. Raffles Mus., no. 3, 1930, p. 123.

*Kalophrynus pleurostigma pleurostigma* Parker, A monograph of the frogs of the Family Microhylidae, 1934, pp. 97-98, figs. 39-40 (*part.*); Inger, Fieldiana Zool., vol. 33, no. 4, July 23, 1954, pp. 416-420 (*part.*).

*Kalophrynus pleurostigma* Boulenger, Catalogue of the Batrachia Salientia s. Ecuadata in the collection of the British Museum, Ed. 2, 1882, p. 158; The fauna of British India, Ceylon and Burma; Reptilia and Batrachia, 1890, p. 490 (*part.*); Flower, Proc. Zool. Soc. London, 1896, p. 908; *ibid.*, 1899, p. 900 (*part.*); Butler, Journ. Bombay Nat. Hist. Soc., vol 15, 1904, p. 387; Boulenger, A vertebrate fauna of the Malaya Peninsula . . . Reptilia and Batrachia, 1912, 258; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1916, p. 168; Nieden, Das Tierreich, Lief. 49, Anura II, 1926, p. 16 (*part.*). Parker, Monograph of the Microhylidae, 1934, pp. 97-98, figs. 39-40.

**Diagnosis:** Body squat, covered usually with very numerous small horny spines tipped with ivory; more or less distinct or diffuse parotoid gland; oval inner metatarsal tubercle, outer absent or indefinite; vocal sac in male. Third toe longer than fifth; second longer than fourth; toes one-third webbed or a little more; nuptial pads on inner fingers.

**Description of species** (from EHT-HMS No. 30264): Body squat; head flat somewhat wedge-shaped; snout little shorter than eye length; interorbital width about one and a half times width of upper eyelid; canthus rostralis obtuse; loreal region nearly vertical, not or but slightly concave; tympanum moderately distinct, covered with skin, close against eye, its diameter (3.5 mm.) more than half length of orbit (4.8 mm.); a skinfold from top of eye extends down, curving above tympanum then down to arm-insertion then back and up above arm, becoming lost on side; dorsolateral fold begins at eye and extends back diagonally to groin.

Choanae entirely concealed when palate is viewed from below; palatal glands empty into distinct curving groove which runs from upper edge of choana across palate; tongue slender, small, free behind for half its length, free on sides, not notched; an elevated dermal ridge curves across palate behind orbits; just behind this denticulated dermal ridge crossing palate; subgular vocal sac opening into mouth through two slits beginning behind angle of mouth then curving forward.

Skin thick, glandular, over upper surface of body, covered with small tubercles or pustules, each with an ivory tip, becoming a little larger, pyramidal, or spinose, laterally. Tubercles present on legs, a few above femur, many on tibia, present but less distinct on foot;



FIG. 100.—*Kalophrynus pleurostigma pleurostigma* Tschudi. EHT-HMS,  
No. 30264, Patiyu, Prachuap Khiri Khan, Thailand.

chin and to lesser extent breast with fine tubercles; venter, much of undersurface, and posterior surface of thighs granulate, the granules or areolae somewhat variable in size.

Arms short; fingers small, tips slightly swollen, distal and proximal subarticular tubercles strongly developed; two metacarpal tubercles, outer very large, flat; three large supernumerary tubercles; nuptial pads on dorsal surface of three inner fingers; legs short, toes half webbed, webs reaching swollen tips as narrow fringes; inner and smaller outer metatarsal tubercles; strong subarticular tubercles; no tarsal fold; tibiotarsal articulation reaches tympanum.

*Color:* Above uniform violet brown, tips of tubercles ivory to cream; a faint lighter dorsolateral line bordered by darker below. Chin and throat smoky; underside of thigh, chin, breast, and anterior part of venter yellowish; small ocelli where the larger tubercles exist.

*Measurements in mm.:* Snout to vent, 40; width of head, 17; length of head, 14.5; diameter of tympanum, 4; arm, 28.5; leg, 53; tibia, 18; foot and tarsus, 22.

*Variation:* The specimens occurring in Thailand and Malaya seem to agree with the Sumatran form. It is possible that more than a single form occurs in Borneo. A second species has been described from Malaya.

*Distribution:* In Thailand the species has been taken only in the southern part, several specimens having been acquired by Dr. Malcolm Smith from Patiyu = Prachuap Khiri Khan. The species occurs in Malaya and the Indo-Australian Archipelago. A handsome species *K. stellatus* occurs in the Philippines.

#### Genus GLYPHOGLOSSUS Günther

*Glyphoglossus* Günther, Proc. Zool. Soc. London, 1868, p. 483 (type of genus, *Glyphoglossus molossus*); Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the British Museum, 2nd. ed., 1882, p. 175.

*Diagnosis:* "Head very short, crown convex; mouth transverse, very narrow; limbs short, eye small; space between and behind the inner nostrils is even without papillae; one papilla in the median line of the hinder part of the palate. Tongue long, free, and notched behind and in front, divided into two lateral halves by a deep groove. Tympanum hidden; openings of Eustachian tubes small. Toes broadly webbed; metatarsus with a large, compressed, cutting shovel-like prominence." Günther (1868).

The following characters also obtain: "prevomer undivided, the post-choanal portion overlying the palatine region, and bearing,

mesially one or two knob-like prominences; no clavicles, procoracoids, or omosternum; sternum cartilaginous; vertebral column diplasiocoelous. Terminal phalanges simple" . . . "A fimbriated ridge across palate in front of pharynx preceded by a median papilla; an indefinite, pigmented dermal ridge behind each choana." Parker, 1934.

It has been pointed out by Parker and others that the genus is closely related to *Uperodon* Duméril and Bibron, and it might be well to unite the genera. However, he maintains them both in his monograph. The species *Uperodon globosum* has an undivided prevomer and this agrees with *Glyphoglossus*. It might be that this form should be placed in the genus *Glyphoglossus*. Material is not at hand for such a study.

### *Glyphoglossus molossus* Günther

FIG. 101

*Glyphoglossus molossus* Günther, Proc. Zool. Soc. London, June 25, 1868, p. 483, pl. 38, fig. 1 (type locality, Pegu, Burma); Boulenger, Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum, 2nd Ed., 1882, p. 175 (Pegu); The fauna of British India . . . Reptilia and Batrachia, 1890, p. 497; Slater, Proc. Zool. Soc. London, 1892, p. 348; Fea, Ann. Mus. Civ. Genova, ser. 2, vol. 17, 1897, p. 473; M. Smith, Journ. Nat. Hist. Soc. Siam, vol. 2, 1917, p. 230; *ibid.*, 1917, pp. 269-270; Nieden, Das Tierreich, Lief. 49; Amphibia, Anura II, Engystomatidae, 1926, p. 21; Cochran, Proc. U. S. Nat. Mus., vol. 77, 1930, p. 8 (Sikiu near Khorat, Nakhon Ratchasima, Thailand); Noble, The biology of the Amphibia, 1931, p. 533, fig. 174; Parker, A monograph of the Microhylidae, 1934, pp. 72-73, fig. 30 ("Paknampo, N. E. Siam; Ta Rua, Central Siam"); Bourret, Annexe au Bull. Inst. Publ., no. 4, 1937, p. 55; *ibid.*, no. 4, 1939, p. 60 (Takeo, Cambodia); Les Batraciens de l'Indochine, 1942, p. 493-495, fig. 179; Taylor and Elbel, Univ. Kansas Sci. Bull., vol. 38, pt. 2, Mar. 20, 1958, pp. 1072-1075, fig. 12.

*Diagnosis:* See diagnosis of genus.

*Description of species* (KUMNH, No. 33519 ♂, Rat Buri, Thailand): Large burrowing frogs, snout and lower jaw very strongly truncate; canthus rostralis not indicated; eye very small, much shorter than distance between eye and tip of snout; upper eyelid heavy, overhanging lower; head strongly convex above; occipital region highest, sloping gradually forwards and downwards to tip of snout; a small fold usually present across head behind eyes, reaching laterally to angle of mouth; choanae diagonally elongate, partly divided by fleshy process from anterior edge; vomerine teeth absent, but two small boletoid bony processes behind, but slightly mesial to choanae, somewhat resembling vomerine teeth; rounded median papule lies immediately in front of, and contiguous with broad transverse fold lying across palate some distance in front of



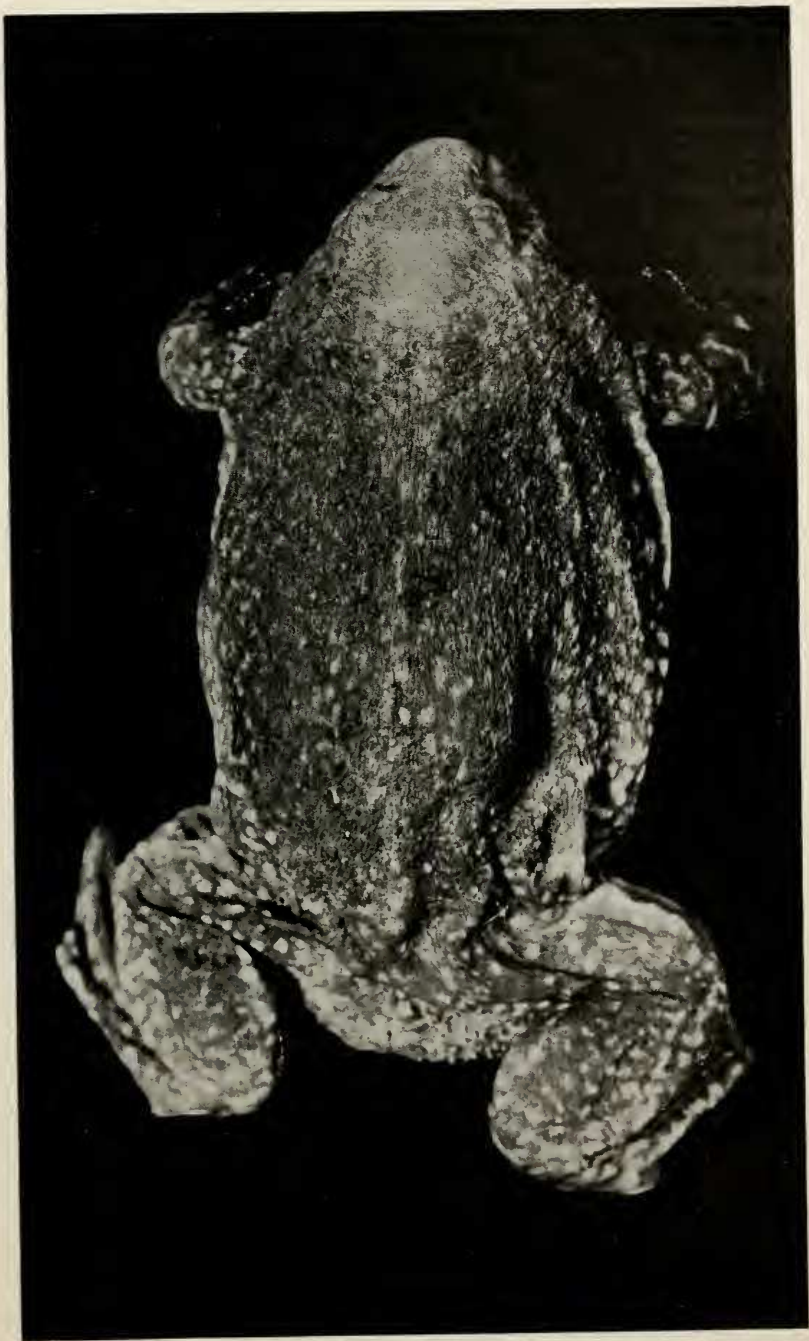


FIG. 101.—*Glyphoglossus molossus* Günther. KU Mus. No. 40018 ♀. Actual snout-vent length, 73 mm. "Thailand."

esophageal opening; tongue rounded and thickened with a suggestion of an anterior notch, and on each side a distinct lateral thickening, leaving strong median depression or groove; these thickenings narrow posteriorly, leaving two diverging fingerlike ridges that fail to reach back edge of tongue; posterior part of tongue free for one fourth of its length; openings of Eustachian tubes large, circular; a vocal sac; two slitlike lateral openings to vocal sac on each side of tongue, near anterior part of mouth; externally transverse folds show position of median vocal sac, which has two extensions running back above arm to shoulder.

Fingers with lateral ridges (or fringes) along their inner sides and with small web-remnant between second and third. Four subarticular tubercles followed by three small tubercles on palm and two large (metacarpal) tubercles, outer elongate extending to back border of palm, inner shorter but more distinct than outer; toes fully webbed, tips somewhat swollen into small terminal discs; three subarticular tubercles; very large free-edged shovel represents inner metatarsal tubercle; small outer tubercle present; when leg is carried forward shovel reaches tip of snout. Skin of face, snout, eyelids, anterior part of lower jaw, and lips covered with tiny firm rounded or spinose tubercles; body skin wrinkled, sometimes showing indistinct granulation. Venter smooth, not granulate.

*Color:* Color generally blackish- to grayish-brown with dorsal and lateral areas of body and limbs with very numerous small to minute light flecks or spots; most of ventral surfaces of chin, body, and limbs whitish to cream, partially clouded.

*Measurements in mm.:* Snout to vent, 60; arm, 31; leg, 81; tibia, 25; foot and tarsus, 36; shovel, 9.

*Variation:* Some specimens have the skin granular on the anal region; in others the front part of the head and chin are beset with numerous small regular pustules; the occipital fold may or may not be present; sometimes the general coloration above is purplish.

*Distribution:* In Thailand specimens have been taken in Chon Buri, Chanthaburi, Rat Buri, and Ayutthaya. Outside of Thailand it has been taken in Burma.

*Remarks:* This species is widespread in Thailand. It is one of the amphibians commonly found in markets, available for human consumption. Several of these are placed on a spit and roasted to a crisp—this without removing the skin or viscera.

Young specimens were found during the dry season burrowed into a sandy bank near a swampy area in Chon Buri.

## ORDER GYMNOPIHIONA

This group was formerly called Apoda, an excellent name for the group but unfortunately the name was used earlier for certain eel-like fishes, and cannot be used for these creatures.

The group may be briefly described as follows: Body wormlike or snakelike, lacking arms, legs, and internal parts of pelvic and pectoral girdles; palatine bones fused to maxillaries; frontals, nasals, parietals, and prefrontals distinct; tail absent or rudimentary; squamosal in contact or not with parietal; eye usually under skin, sometimes under bones of skull. Males with terminal part of gut modified, so that when exerted it serves as an intromittent organ for internal fertilization. Young usually transform from an aquatic, larval, water-breathing condition to an adult air-breathing state.

The species of this Order at the present time are regarded as belonging to a single family, Caeciliidae, and are commonly referred to as the Caecilians.

This group of animals is not well-known and on first seeing them one is more likely to associate them with worms or snakes rather than with amphibians.

The caecilians, unlike their relatives the frogs and toads do not announce their presence by singing loudly. These are very secretive, silent animals, living underground most of their lives. Most species place their eggs near water, and these, when they hatch, permit the young to enter water and live like fishes. They take their oxygen from the water through gills at first. Later they lose their gills, leave the water, and become burrowing animals. These creatures, like most vertebrate animals living under the ground, have lost their arms and legs; their eyes have become changed and perhaps nonfunctional, and the animal has learned a new method of locomotion similar to that of snakes or legless lizards.

The caecilians have become still further modified. Not only have the arms and legs disappeared but even the bones within the body that normally support the arms and legs have disappeared. The tail has become reduced in size so that it is sometimes less than one-half millimeter long in certain Indian species (which may be said to lack tails), or three to seven millimeters long in certain Thai species.

Another curious characteristic of the caecilians is that in many species there are scales present; but unlike fishes, lizards and snakes in which the scales are on the surface of the body, the scales in these animals are hidden below the surface in skin-folds that pass around

the body. In all species where they occur they are completely or practically concealed. In some species the scales may be absent from all or a part of the body while in the posterior part of other species there may be as many as five to nine scalerows in a single fold. In various parts of the body the scales may vary in size from tiny ones less than one fourth of a millimeter in size to larger ones 3 millimeters in diameter, and various sizes may occur in the same specimen, sometimes in the same fold. The number of rows around the body may total more than a thousand, in some cases perhaps nearer two thousand.

The skin of the body contains a very large number of glandules that produce secretions of mucus on the body. The largest of these may be two to three millimeters in length, lying nearly horizontal and forming a closely-packed row around the body in (or between) each fold.

The folds tend to make circles around the body, and are separated by fine grooves. In most of the species known in Thailand the folds are very numerous (250 to 380). They curve forward on the upper surface of the body and on the sides are directed downwards, while on the under surface they curve backwards and meet on the middle line of the body in a rather sharp angle throughout most of the body. However, in the posterior part of the body, the folds run straight across the ventral surface.

The anal opening, in Thailand species, is a narrow longitudinal slit into which several grooves enter. The back part of the intestine in the males is thickened with some especially developed organs. The intestine may be extruded and may serve as an intromittent organ for fertilizing the eggs of the female internally. This organ does not occur in either the Salientia (frogs, toads, etc.) or the Caudata (salamanders).

The eye is usually visible in the Thailand species although it is covered with skin and other tissues which may be partly transparent. It does not seem possible for the eye to serve the animal other than to determine light intensity. Anterior to the eye, and variously placed between the eye and the nostril is a small organ, the tentacle, which may be everted and retracted. It is usually shaped like a minute cone, and one or two millimeters long when extruded and doubtless serves the animal as a sense organ of some kind. The nostrils are placed far forward near the tip of the snout.

The teeth are important in differentiating caecilian species. There are four sets of teeth. In the upper part of the mouth the maxillary-premaxillary series forms a line around the edge of the upper jaw,

associated with the maxilla and the premaxillary \* bones. Just behind the first row is a second series, the vomeropalatine, which is associated with the prevomer and palatine bones but usually forms a continuous series.

The lower jaw has a series of teeth bordering the mandible (or dentary); and behind this is a series of splenial teeth associated with the splenial bone. In certain caecilians including some Asiatic species, the splenial teeth may be entirely absent. In others the number may be reduced to only two median teeth while in other species the number may reach or exceed 50 teeth.

The tongue is fastened on all sides, sometimes covering the splenial teeth. It cannot be extruded from the mouth.

It is difficult to determine (except with a skeleton at hand) the exact length of the head, since the region back of the head is wider than the skull. This is caused by two large folds that are called the first and second collar. Usually there is a groove at the front and back part of each of these collars but often the grooves are dim and may not completely surround the collars. Sometimes the collars may be divided above by grooves marking folds; as many as three may be present in certain species in the second collar, one or two in the first. In other species no grooves or folds are evident.

Occasionally there may be a dorsolateral ridge on each side of the body. Since this may be the result of contraction of muscles after death, it may not be a permanent character. The nature of this fold is not known at present.

The larvae, before they hatch from the eggs, develop three dendritic gills that may grow to a length of from ten to twenty millimeters. These may be retained for a few weeks then they are re-absorbed and one pair of gill opening (or in some species two) may remain until the animal transforms into its adult form, at which time the gill openings close, and the caudal fin is lost.\*\*

The size of the larvae varies greatly. In some species the transformed larva may be as small as 130 millimeters in total length. In one Thailand species the larvae transform after they have reached a length of 240 millimeters.

The lateral-line sensory organ (neuromast organs) well known in fishes is present in larvae caecilians. Usually it can be discerned on the heads of very young specimens only. In other species it appears visible and presumably functional during the entire larvae life.

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\* This bone may be fused with the nasal bones.

\*\* One South American species remains in the water all its life and the fin, which runs the length of the body is retained during life.



## FAMILY CAECILIDAE

The family Caecilidae comprises some twenty recognized genera as follows:

<i>Amphiumophis</i>	<i>Gymnopsis</i>	<i>Rhinatrema</i>
<i>Boulengerula</i>	<i>Herpele</i>	<i>Scolecophorus</i>
<i>Cthonerpeton</i>	<i>Hypogeophis</i>	<i>Schistometopum</i>
<i>Caecilia</i>	<i>Idiocranium</i>	<i>Siphonops</i>
<i>Dermophis</i>	<i>Indotyphlus</i>	<i>Typhlonectes</i>
<i>Geotrypetes</i>	<i>Ichthyophis</i>	<i>Uraeotyphlus</i>
<i>Gegeneophis</i>	<i>Praslinia</i>	

Of these *Ichthyophis* occurs in Asia wherever caecilians are to be found. *Indotyphlus*, *Gegeneophis*, and *Uraeotyphlus* are endemic to India and not known elsewhere. *Herpele*, an African genus has been included in the Asian fauna on the basis of a single specimen of a species named *Herpele fulleri* by Alcock, discovered at Cachar in Assam.

In a recent preliminary study\* I have recognized some 24 forms of *Ichthyophis*, and realized the necessity of recognizing others when certain data were made available on the Linnaean type of *I. glutinosus*.

Although all the 24 forms were treated as full species it is entirely possible that certain of them may more profitably be regarded as subspecies when a greater material is available for study.

At the present time I am engaged in further exploration and study of the Asiatic and other Caecilians with a hope of clarifying these relationships.

*Diagnosis:* The characters of the family Caecilidae may be regarded as being the same as those of the order (*vide supra*).

Genus *ICHTHYOPHIS* Fitzinger

*Ichthyophis* Fitzinger, Neue Klassifikation der Reptilien nach ihren natürlichen Verwandtschaften. Nebst. einer Verwandtschafts-tafel und einem Verzeichnisse der Reptilien-Sammlung des k.k. Zoologischen Museum's zu Wien, 1826, p. 36. Type of genus *Caecilia glutinosa* (by monotypy).

*Diagnosis:* Squamosals in contact with parietals. One or two series of teeth in lower jaw, splenial series sometimes absent; a tentacle near lip, closer to eye than to nostril; scales imbedded in skin, present in all known species but variable in number and position on body; number of folds, 240-416 (the primary and secondary folds cannot be easily differentiated).

Vertebrae from 102-123; orbit of eye circular, complete, or broken by tentacular groove.

\* Taylor, Univ. Kansas Sci. Bull., vol. 40, Apr. 20, 1960, pp. 37 to 120.

In Thailand only a single genus, *Ichthyophis* has been found. It is represented by at least four species.

KEY TO THE SPECIES OF *ICHTHYOPHIS* IN THAILAND

1. No lateral cream or yellow stripe from head to tail ..... 2  
     A cream or yellow lateral stripe on body ..... 3
2. Larvae reaching a large size (240 mm.); transverse folds, dorsal count, 314-325.\* Body width in length 16-17.5 times. Scales absent in the anterior third of body, reduced to a single row when present. Tooth formula; maxillary-premaxillary 21-22, vomeropalatine 21-22; mandibular 20-20; splenial, 12-12 ..... *youngorum*  
     Larvae transforming at from 200-205 mm. in length. Body width in length 20 times; two rows of scales in a fold where present; transverse folds, 315-332; maxillary-premaxillary teeth, 25-25; vomeropalatine, 26-27; mandibular, 25-24; splenial, 22-22; snout acuminate ..... *acuminatus*
3. A narrow cream or yellow stripe. In adult tail length in total length 102 times; body width in body length approximately 30.6 times; head width 9.2 mm., head length, 13 mm. Total length 306 mm.; teeth, maxillary-premaxillary, 31-32; vomeropalatine, 27-27; mandibular, 8-6; splenial 18-18. Folds vary between 306 and 322. . . . *supachaii*  
     A broad cream or yellow stripe; mandibular teeth not reduced in number ..... 4
4. Transverse folds 289-320; maxillary-premaxillary teeth in adults (300 mm. or more in length), 20-24 on each side; vomeropalatine 20 to 22 on each side; mandibular 20-21 on each side; splenial, 12-14 on each side; tail in total length about 79 times; body width in total length approximately 20 times ..... *kohtaoensis* subsp.?  
     Cream or yellow lateral stripe widening on back part of head, one short branch bordering lower jaw, the other terminating below eye. Transverse folds 362-366; maxillary-premaxillary teeth, 22-23; vomeropalatine, 22-23; mandibular, 21-20; splenial, 17-18; tail length in total length, 60-66; width in length 23 times . . . *kohtaoensis kohtaoensis*

*Ichthyophis acuminatus* Taylor

FIG. 102

*Ichthyophis acuminatus* Taylor, Univ. Kansas Sci. Bull., vol. 40, Apr. 20, 1960, pp. 98-101, figs. 32, 33 (type locality, Me Wang Valley, northern Chiang Mai province, Thailand).

**Diagnosis:** Large form (known length, 300 mm.); head acuminate; tentacle near lip, twice as close to eye as to nostril; eye visible, very small; splenial teeth in transformed specimens 15-22 in each side of jaw; tail short without orange or yellow spot at vent; scales present in posterior part of body; absent or greatly reduced in anterior part; body width in total length (in adults), about 20 times; dorsal count of transverse folds on body and tail, 315-332; on venter,

\* Ventral counts average 29 lower. Tooth totals in larvae are lower.

297-320; vertebrae, 109-110; larvae transform at length of about 200 millimeters.

*Description of species* (from type, American Mus. Nat. Hist., No. 20875): Body thick, head acuminate, rather elongate, when seen from above rather triangular; eye visible, very small, .7 mm. in diameter; tentacle minute, conical, the opening somewhat horseshoe-shaped, near edge of mouth, but closer to eye (1.7 mm.) than to the nostril (3.8 mm.); width between eyes—measured in a straight line, 7 mm.; length of snout from eyes forward, 5.8 mm.; the snout tip extends 1 mm. beyond mouth. Width of head, 11.6 mm.; head length to first groove 14 mm.; first nuchal groove preceding first collar well defined on sides of head and under chin; second between collars distinct ventrally and laterally; third groove behind second collar scarcely indicated.

Primary and secondary folds cannot be differentiated, but a number of presumed secondary folds do not reach ventral surface so that dorsal counts of folds are greater than lateral or ventral. Folds meeting on ventral surface at an angle; in posterior part of body they pass straight across venter without an angle. Total folds counted dorsally, 315; on venter, 303. Scales absent or very small and few in anterior half of body; posteriorly there are one or two usually complete rows in each fold; longitudinal anal vent interrupts six folds; tip of tail pointed, flat ventrally and somewhat compressed laterally.

Tongue rather pointed, not free, covering large series of splenial teeth, many of which seem not to have completely penetrated gums.

Teeth: maxillary-premaxillary, 24-25 on the two sides of the upper jaw; vomeropalatine, 26-27; mandibular (dentary) 25-24; splenial, 22-22, smaller than other teeth.

*Color*: Somewhat violet-lavender, nearly uniform above tending to be somewhat lighter on throat and chin; no cream or yellow spot at vent; a cream area about tentacle; lips light cream.

*Measurements in mm.*: Total length, 295; tail, 7 (from front of vent); head width at first groove, 11.6; head length, 14; body width, 14.6; body width in length, 20 times.

*Variation*: Specimens long preserved may be dull slate or sometimes brownish in color. The number of teeth is smaller in the larvae and recently transformed specimens; the splenials vary from 15-15 to 22-22; the folds vary between 315-330 on dorsum; 297 to 300 in the ventral counts. The vertebrae (2 specimens) are 109-110. The larvae transform at a length of about 205 millimeters

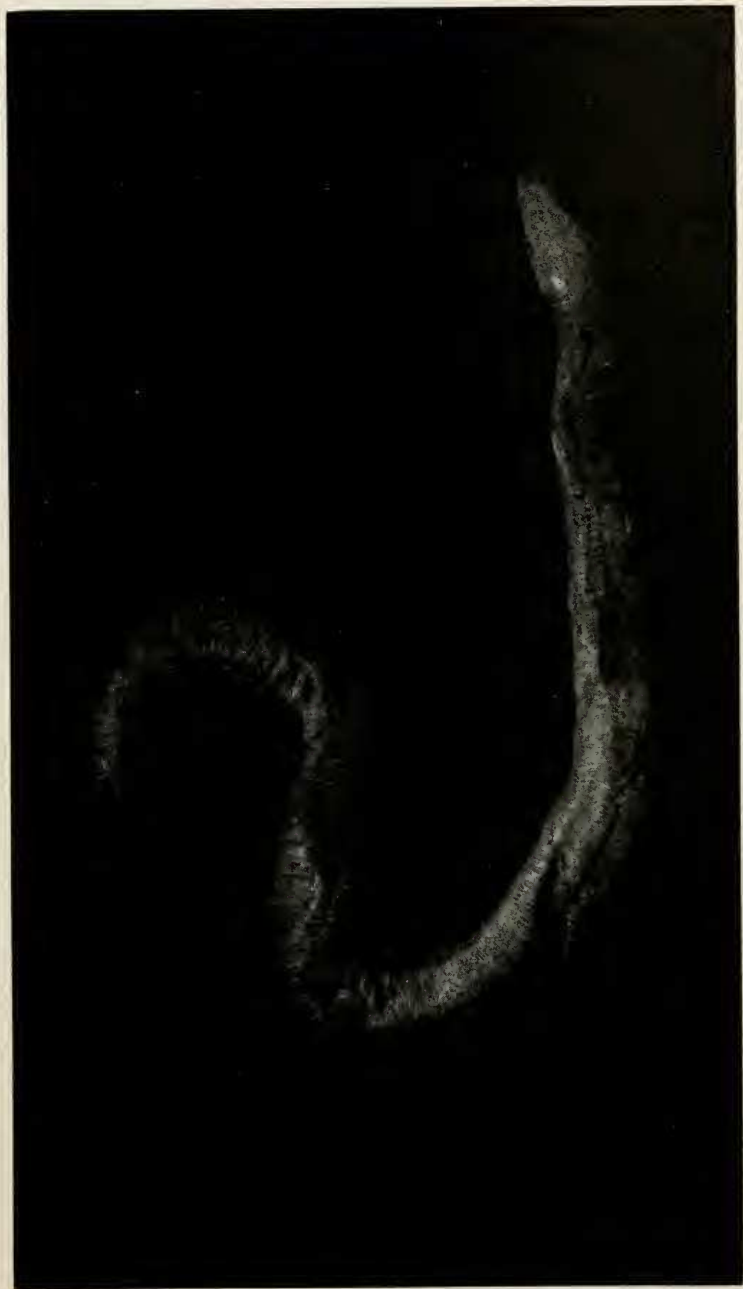


FIG. 102.—*Ichthyophis acuminatus* Taylor. Type. Me Wang Valley, Chiang Mai (province) Thailand. Actual length, 295 mm.

since of three specimens examined of this length, two were transformed and one was still larval.

*Distribution:* The species has been taken only in northern Thailand at "Muang Liep" and at Pa Meang in the Me Wang Valley, in the province of Chiang Mai.

It has not been taken elsewhere.

*Ichthyophis supachaii* Taylor

FIG. 103

*Ichthyophis supachaii* Taylor, Univ. Kansas Sci. Bull., vol. 40, 1960, pp. 107-110, figs. 36, 37 (type locality, 10 km. W Nakhon Si Thammarat, Nakhon Si Thammarat province, Thailand).

*Diagnosis:* A relatively-slender elongate species, largest known 306 mm. long; a rather narrow lateral cream stripe broken on neck, and, in the adult type, numerous white or cream spots both on dorsum and venter; body width in length, 30.6 times; tail in total length, 102 times; mandibular teeth reduced in number, splenials 18-18, relatively prominent; transverse folds, 313-332. Larvae transform at small size (before 125 mm. is reached).

*Description of species* (from type specimen): Head seemingly a little more flattened proportionally than in other Thai species, height 32 mm.; head width, 9.2 mm.; head length, 13 mm.; distance between eyes (6.2 mm.) greater than length of snout in front of eyes (5 mm.); tentacle rather conical, the opening lunate, closer to eye (1.8 mm.) than to nostril (3.5 mm.); tip of snout to first nuchal groove, 13 mm.; to second, 16.4, to third, 20. Total number of transverse folds, 322, of which 4-5 are on tail. Grooves separating folds fail to cross the back either dorsally or ventrally, except posteriorly; folds form a posteriorly directed angle on venter. Scales absent on anteriormost folds; when they begin to appear they are small (one-half millimeter in diameter) and do not form a complete row around body. More posteriorly, three to five complete rows of distinctly larger imbricating scales in each fold.

*Teeth:* Maxillary-premaxillary, 31-32; vomeropalatine, 27-27; mandibular, 8-6; splenial, 18-18; tongue oval, narrowed anteriorly, not covering (perhaps not reaching) splenial teeth.

*Color in life:* Above dark plumbeous-lavender; gray-slate below; a dark collar around neck preceded on side by a cream spot near angle of mouth and a second spot on side of neck. A cream stripe begins at third nuchal groove and runs along sides, continues to point in front of level of vent; numerous flecks and small spots of cream both dorsally and ventrally. Eye with an incomplete ring





FIG. 103.—*Ichthyophis supachaii* Taylor. Type. 10 km. W Nakhon Si Thammarat (city), Thailand. Actual length, 305 mm.

of cream; cream spot at tentacle and vent; a small median cream spot on occiput.

*Measurements in mm.*: Total length, 306; tail length, 3; width of body, approximately, 10; width of head, 9.2; length of head, 13; width in length, 30.6 times; tail in total length, 102 times.

*Variation*: One of two small specimens measuring each 125 mm. taken at the same place as the type specimen presumably has transformed recently from the larval state, since there is still a trace of the caudal fin at the end of the tail. The transverse folds number 313. The teeth foreshadow the condition in the adult. All the series are greatly reduced. I count only five maxillary-premaxillary teeth on each side and seven in the vomerine series. Of the mandibular series there is a tiny median pair, then three widely spaced enlarged teeth with a single tooth in the posterior part of the jaw on one side, two on the other.

*Distribution*: Certain other larvae were taken near Trang, at the Khao Chong Forest Station, and in Nakhon Si Thammarat at the Tonka Harbor Tin Mine near Ronpibon. A transformed specimen was taken at a point, 18 kilometers northeast of Bhetong.

Further collections will probably show a greater range for the species.

*Ichthyophis youngorum* Taylor

FIGS. 104, 105

*Ichthyophis youngorum* Taylor, Univ. Kansas Sci. Bull., vol. 40, 1960, pp. 84-91, figs. 23-27 (type locality, Doi Suthep (Sutep) about 1000 m. elevation, near Chiang Mai, Chiang Mai Province, Thailand).

*Diagnosis*: A medium-sized species reaching a known length of 220 mm. for adults; 240 mm. for the largest larva; transverse body folds, 310-326 (dorsal count), six on tail; 276-304 ventral count; body width in total length, 16-17.5 times; tail length in total length approximately 40 times, head not acuminate, and anteriorly somewhat broader proportionally than *acuminatus*. Larvae transforms at a length of about 240 mm. Scales apparently absent or rare in anterior one third of body; when they first appear, they are very small, transversely widened; posteriorly there is a single row in each fold.

*Description of species* (from type): A somewhat cylindrical body, 210 mm. long; the width (12 mm.) contained in length 17.5 times; eye distinct; tentacle from lip, .35 mm.; from eye, 1.3 mm.; from nostril, 2.6 mm.; head width at first nuchal collar, 9 mm.; head

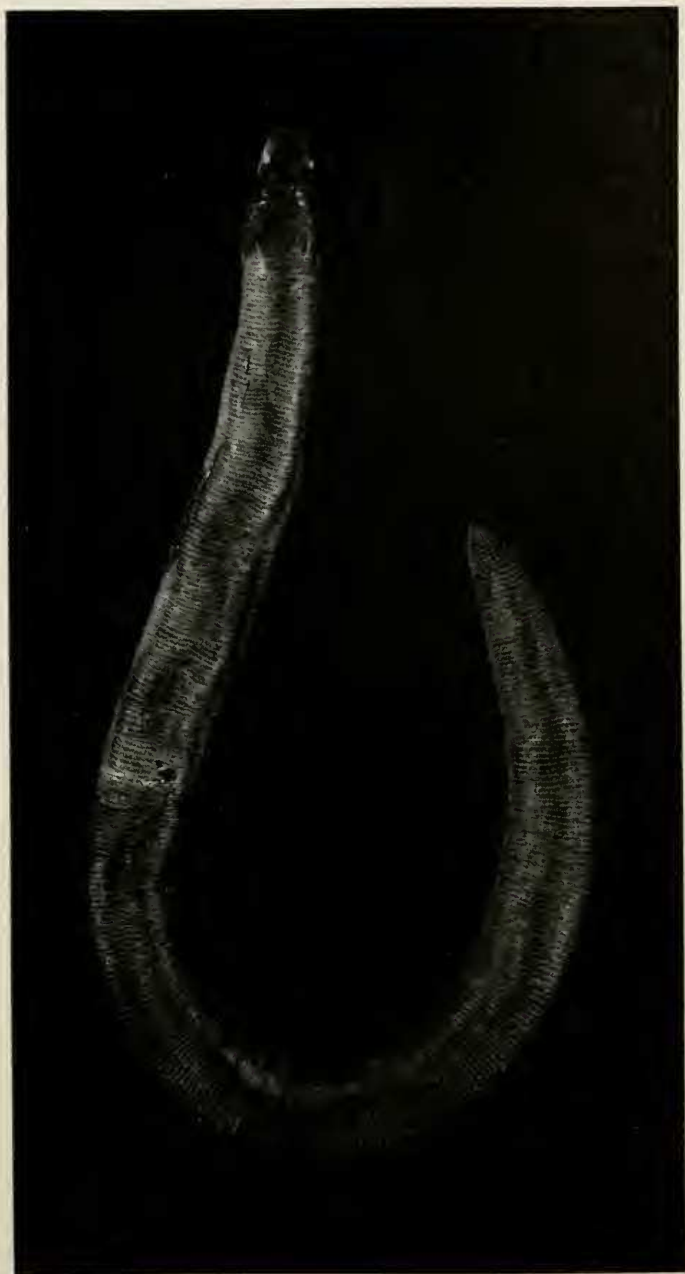


FIG. 104.—*Ichthyophis youngorum* Taylor. Type. No. 35946; Doi Suthep, Chiang Mai, Thailand. Elev., 3900 ft. Actual length, 210 mm., dorsal view.

length from same, 12 mm.; distance between eyes, 4.9 mm.; snout length, 4.3 mm.; tentacle cone-shaped, opening lunate.

First groove (preceding first nuchal collar) dimly visible on throat; second groove well visible on throat and sides of neck; third groove behind the second collar, dim even laterally; a median longitudinal groove on chin extending to throat; tip of snout to third groove measured laterally, 16.5 mm.

Primary and secondary folds 324 (dorsal count) generally not distinguishable one from the other, but many secondaries fail to reach the venter so the dorsal, lateral, and ventral count of folds are progressively smaller; lateral count, 304; ventral count, 280, four folds interrupted by vent; six folds on tail; a pair of dorsolateral ridges partly indicated; body folds curve slightly forward on dorsum then curve back and meet on the ventral surface at an angle, except posteriorly where they pass directly across venter; vertebrae, 107.

Scales absent in anterior part of body; present at least in latter two thirds; where they first appear they are very small, transversely widened; posteriorly they form a single overlapping row in each fold.

*Teeth:* Maxillary-premaxillary series, 21-22; vomeropalatine, 21-22; mandibular, 20-20; splenial, 12-12.

*Color in life:* General color, violet to lavender above, more lavender ventrally; grooves between folds, partly due to glands in the skin, appear light gray; chin brownish black; head dark plumbeous; a gray-white spot in front of eye more or less connected with a gray spot around tentacle; a slightly distinct light area about nostril; edges of vent are gray-flesh with two small glands apparent on each side of anterior end.

*Measurements in mm.:* Total length, 210; tail, 5.2; body width, 12; head length, 12; head width, 9.

*Variation:* Another specimen, an adult topotypic paratype is almost an exact counterpart of the type. It measures 220 mm. in length, 12.2 mm. in body width. The dorsal count of transverse folds is 328, the lateral count, 292, the ventral, 285. There are 106 vertebrae. Most other characters are very similar to the type.

The known habitat of this species is a mountain rivulet on Doi Suthep. All were taken in gravel and mud, under rocks in very shallow water. Numerous larvae were taken. The large size of the larvae suggested that they might be neotenic; however, I found no internal evidence that this might be true in specimens dissected.

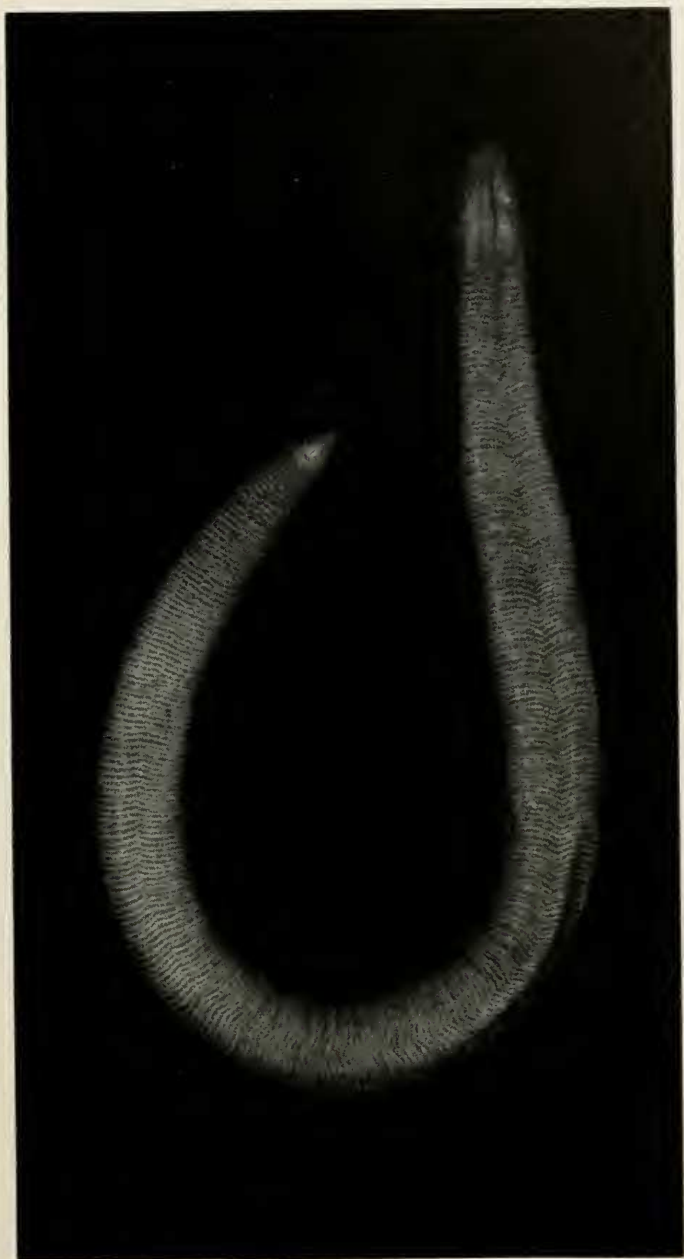


FIG. 105.—*Ichthyophis youngorum* Taylor. Type. No. 35946, ventral view. Actual length, 210 mm., ventral view.





FIG. 106.—*Ichthyophis kohtaoensis kohtaoensis* Taylor. Type.  
Koh Tao (island), Gulf of Siam. Actual length, 280 mm.

*Ichthyophis kohtaoensis kohtaoensis* Taylor

FIG. 106

*Ichthyophis kohtaoensis* Taylor, Univ. Kansas Sci. Bull., vol. 40, 1959, pp. 110-113, fig. 38 (type locality, Koh Tao island, western part of Gulf of Siam, Thailand).

**Diagnosis:** A species having a wide lateral cream stripe, a well-developed series of splenial teeth, 17-18 in older specimens; mandibular teeth, 22-23; vomeropalatine teeth very small, scarcely penetrating gums. Transverse folds, 362-366; width in length about 24 times.

**Description of species** (from type): Head rather narrow, the region behind head (1st and 2nd collars) wider than head; head width at first groove, 8.7 mm., head length, 12.1 mm.; width between eyes approximately 5.6 mm. measured in a straight line; snout length (level of eyes to snout-tip) 4.4 mm.; tentacular opening small, curved, near edge of lip, closer to eye (1.7 mm.) than to nostril (3 mm.). Eye distinct, surrounded by a narrow cream ring. First nuchal groove distinct below and on sides; second, strong below reaching laterally above cream lines; third groove bordering second collar cannot be traced except ventrally; second collar divided by three transverse folds.

Transverse folds, 362-366, curving somewhat forward dorsally, ventrally turned back and forming a distinct angle mesially except posteriorly; grooves between folds fail to cross venter except posteriorly where folds cross venter in a straight line; vent interrupts four of six folds confined to tail.

Scales present anteriorly (probably some present on folds on collar); at first only one or two small scales can be found; gradually they increase in number and size and posteriorly at least four imbricating rows are present in each fold extending around body.

**Teeth:** Maxillary-premaxillary, 22-23; vomeropalatine, 22-23; mandibular, 20-21; splenial, 17-18. Vomeropalatine teeth small, scarcely penetrating the gums.

**Color:** Generally lavender brown, grooves slightly lighter than elsewhere; broad lateral cream stripe bifurcates at mouth angle, branch going on lower jaw soon becoming brownish, that on upper jaw extends to eye; stripe extends posteriorly to a point somewhat in advance of the vent. A cream spot at tentacle, nostril, and vent; tip of snout lighter than remainder of head. A narrow cream ring about eye.



FIG. 107.—*Ichthyophis kohtaoensis* subsp?

*Measurement in mm.* (Type and paratype): Snout to vent, 280, 192; tail, 4.2, 3.3; head width, 8.7, 6.9; length of head, 12.1, 9.6; width of body, 12.2, 8.2; width in length (times), 23, 23.4; tail length in total length (times), 66.6, 60.

*Variation:* The paratype has a pair of tiny triangular spots on the sides of the vent, a shade lighter than the spot at vent. There are 366 folds. Because the cotype is a younger specimen, the teeth are fewer as is generally typical of younger specimens.

*Ichthyophis kohtaoensis* subsp?

A population of *Ichthyophis* whose identification could not be completed when I pursued my study in 1960, owing to lack of data on the type species *Ichthyophis glutinosus*, is being treated elsewhere by me and is mentioned here as assurance that it has not been forgotten. This is a common form of *Ichthyophis* in Thailand, at least from Bangkok to northern and eastern Thailand.

# INDEX

Aeluophryne	283	Grandison, Miss Alice G. C.	270
Anilystoma jeffersonianum	275, 278	Gymnophiona	275, 276, 579
Amolops	473	Hambaananda, Nai Pit	271
Amolops afghanus	473	Hazelia	480
Ansonia	322, 339	Hazelia picta	506-509
Ansonia penangensis	339	Hazelia spinosa	505
Atelopodidae	282, 341	Hellenius, Dr.	270
Battersby, Mr. J. C.	270	Heuser, Dr. (Mrs.) Georg	270
Boeseman, Dr. M.	270	Heuser, Dr. Georg	270
Boo-Liat, Mr. Lim	271	Hinchiranan, Nai Sompol	271
Boschma, Dr. H.	270	Hydrostentor pantherinus	368
Bufo	323	Hyla	345
Bufo asper	324, 326-329	Hyla albotaeniata	346
Bufo borbonica	342	Hyla amectens	345-346
Bufo jerboa	342	Hyla arboricola	346
Bufo macrotis	324, 324-326	Hyla bambusicola	346
Bufo melanostictus	324, 332-335	Hyla chalconota	433
Bufo nidae	282, 322	Hyla erythraea	417
Bufo parvus	324, 329-332	Hyla euphorbiacea	346
Bufo panengensis	339	Hyla eximia	346
Caecilia glutinosus	582	Hyla lafrentzi	346
Cacophryne	341, 342	Hyla leucomystax	496
Cacophryne borbonica	342-344	Hylarana chalconota	433
Calluella	569	Hylarana erythraea	417
Calluella guttulata	569-572	Hylaplesia achatina	539
Calophrynus pleurostigma	573	Hylaplesia borbonica	341, 342
Callula guttulata	569	Hyla wrightorum	346
Callula mediolineata	566	Hylidae	282, 344
Callula natatrix	560	Hylorana jerboa	462
Caudata	274, 275, 278	Hylorana macrodactyla	421
Ceratophryne montana var.	284	Hylorana nicobariensis	430
Ceratophryne nasuta	284	Hylorana pipiens	453
Chirixalus	480	Hylorana subcaerulea	421
Chirixalus doriae	531, 537	Hylorana tytleri	453
Chirixalus hansenae	526	Ichthyophis acuminatus	583-586
Cochran, Dr. Doris	270	Ichthyophis	276
Cynops	275	Ichthyophis kohtaoensis	592-594
Degerbol Hansen, Mrs. Birgit	271	kohtaoensis	592-594
Diplopelma berdmorei	560	Ichthyophis kohtaoensis	594, 595
Diplopelma ornatum	551	subsp?	594, 595
Diplopelma pulchrum	548	Ichthyophis supachaai	586-588
Dyscophina voltzi	569	Ichthyophis youngorum	276, 588-591
Eiselt, Dr. Joseph	270	Ixalus asper	519
Elachyglossa	346, 360	Ixalus bimaculatus	534
Elachyglossa gyldenstolpei	360-362	Ixalus horridus	510
Engystoma berdmorei	560	Ixalus horridum	517
Engystoma ornatum	551	Ixalus parvulus	523
Engystoma pulchrum	548	Ixalus pictus	505, 506
Fehlmann, Dr. H. A.	271	Junhattiti, Nai Samrith	271
Glyphoglossus	575-576	Kahsbauer, Dr. D.	270
Glyphoglossus molossus	576-578	Kalophrynus	572



Kalophrynus pleurostigma . . . . .	573	Megophrys carinensis . . . . .	284, 292
Kalophrynus pleurostigma pleurostigma . . . . .	573-575		293-295
Kaloula . . . . .	336	Megophrys feae . . . . .	284, 296-298
Kaloula mediolineata . . . . .	566-569	Megophrys hasselti hasselti . . . . .	312
Kaloula pulchra . . . . .	563	Megophrys longipes . . . . .	284, 291
Kaloula pulchra pulchra . . . . .	563-566	Megophrys longipes maosonensis, . . . . .	302
Kananuracks, Nai Prayoon . . . . .	271	Megophrys major . . . . .	284, 302-306
Key to Bufo . . . . .	324	Megophrys nasuta . . . . .	284, 285
Key to Bufonidae . . . . .	323		286, 291
Key to Microhyla . . . . .	540	Megophrys parva . . . . .	284, 299
Key to Pelobatidae . . . . .	284		299-302
Key to Philautus . . . . .	523	Megophrys pelodytoides . . . . .	317
Key to Rana . . . . .	362-365	Megophryinae . . . . .	283
Key to Ranidae . . . . .	346	Munkolli, Dr. Norman . . . . .	271
Key to Rhacophorus . . . . .	481-482	Mertens, Dr. Robert . . . . .	270
Key to Salientia . . . . .	282	Meyer, Mr. Joseph . . . . .	271
Klemmer, Dr. Konrad . . . . .	270	Microhyla . . . . .	539
Lekagul, Dr. Boonsong . . . . .	269, 271	Microhyla achatina . . . . .	554
Leptobranchella . . . . .	283	Microhyla annamensis, . . . . .	540, 542-543
Leptobranchium . . . . .	383, 307	Microhyla annectens . . . . .	540-541
Leptobranchium carinense . . . . .	292, 296	Microhyla berdmorei . . . . .	560-563
Leptobranchium feae . . . . .	296	Microhyla boulengeri . . . . .	557
Leptobranchium hasseltii . . . . .		Microhyla butleri . . . . .	557-559
hasseltii . . . . .	307, 312-316	Microhyla (Engystoma)	
Leptobranchium		berdmorei . . . . .	560
hendricksoni . . . . .	307, 308-312	Microhyla eremita . . . . .	551
Leptobranchium		Microhyla fissipes . . . . .	554
minimum . . . . .	307, 320-322	Microhyla fowleri . . . . .	560
Leptobranchium monticola, . . . . .	299, 302	Microhyla grahami . . . . .	557
Leptobranchium oshanensis . . . . .	322	Microhyla hainanensis . . . . .	548, 557
Leptobranchium parvum . . . . .	299	Microhyla heymonsi . . . . .	554-557
Leptobranchium pelodytoides . . . . .	307	Microhyla inornata	
Leptomantis bimaculatus . . . . .	534	lineata . . . . .	540, 546-548
Lilipan, Nai Mann . . . . .	271	Microhyla inornata	
Lilipan, Nai Vatana . . . . .	271	inornata . . . . .	540, 543-546
Limnodytes erythraeus . . . . .	417	Microhyla latastii . . . . .	557
Limnodytes luctuosa . . . . .	451	Microhyla major . . . . .	548
Limnodytes nigrovittatus . . . . .	440	Microhyla malcolmi . . . . .	560
Lymnodytes chalconotus . . . . .	433	Microhyla melli . . . . .	548
Lynn, Mr. Lynn . . . . .	271	Microhyla ornata . . . . .	551-554
Macropelobates . . . . .	283	Microhyla pulchra . . . . .	540, 548-551
Megalophrys carinensis . . . . .	292, 293	Microhyla sowerbyi . . . . .	557
Megalophrys feae . . . . .	296	Micrixalus diminutiva . . . . .	350
Megalophrys guttulata . . . . .	569	Micrixalus magnapustulosus . . . . .	351
Megalophrys hasseltii . . . . .	312	Mongkol, Mr. . . . .	271
Megalophrys longipes . . . . .	291, 302	Microhylidae . . . . .	282, 539
Megalophrys montana, 284, 285, . . . . .	287	Nectes obscurus . . . . .	326
Megalophrys major . . . . .	302	Nectophryne . . . . .	336, 339, 341
Megalophrys montana aceras . . . . .	288	Nectophryne borbonica . . . . .	342
Megalophrys nasuta . . . . .	285	Nectophryne everetti . . . . .	336
Megalophrys parva . . . . .	299	Nectophryne hosii . . . . .	336
Megalophrys pelodyloides . . . . .	317	Nectophryne sumatrana . . . . .	342
Megophrys . . . . .	283	Nesobia . . . . .	283
Megophrys aceras . . . . .	284, 287	Nesomantis . . . . .	283
	288, 289, 291	Noah, Mrs. Lynn . . . . .	271
		Ooeidozyga . . . . .	346

<i>Ooeidozyga laevis</i> .....	358	<i>Rana allicola</i> .....	453-456
<i>Ooeidozyga lima</i> .....	347-350	<i>Rana blythii</i> .....	386-390
<i>Ophryophryne</i> .....	322	<i>Rana burkhilli</i> .....	371
<i>Oreobatrachus</i> .....	350	<i>Rana cataracta</i> .....	465
<i>Oxydozyga martensii</i> .....	358	<i>Rana cancrivora</i> .....	377-379
<i>Oxyglossus lima</i> .....	347	<i>Rana cancrivora raja</i> .....	373, 377
<i>Oxyglossus martensii</i> .....	358	<i>Rana cavitympanum</i> .....	474
<i>Paramesotriton</i> .....	275	<i>Rana chalconota</i> .....	433-436, 465
<i>Pedostibes</i> .....	322, 335-336	<i>Rana chloronata</i> .....	468
<i>Pedostibes hosii</i> .....	336, 336-339	<i>Rana cubitalis</i> .....	424-427
<i>Pelobates</i> .....	283	<i>Rana cyanophlyctis</i> .....	
<i>Pelobatidae</i> .....	282, 283, 284	<i>cyanophlyctis</i> .....	365-368
<i>Pelobatinae</i> .....	283	<i>Rana decorata</i> .....	451
<i>Pelophryne</i> .....	322	<i>Rana doriae</i> .....	390-392, 393
<i>Pelophryne guentheri</i> .....	322	<i>Rana durheimi</i> .....	465
<i>Philautus</i> .....	480, 522	<i>Rana erythraea</i> .....	417-420
<i>Philautus anodon</i> .....	509	<i>Rana erythraea elongata</i> .....	431
<i>Philautus asper</i> .....	519	<i>Rana fusca</i> .....	386
<i>Philautus asperrimus</i> .....	519	<i>Rana glandulosa</i> .....	436-439
<i>Philautus bimaculatus</i> , .....	523, 534-536	<i>Rana gracilis</i> .....	380
<i>Philautus doriae</i> .....	523, 528	<i>Rana gracilis andamanensis</i> .....	412
.....	537-539	<i>Rana hainanensis</i> .....	474
<i>Philautus flavosignatus</i> .....	509	<i>Rana hascheana</i> .....	412-417
<i>Philautus hansenae</i> .....	523	<i>Rana hosii</i> .....	465-468, 474
<i>Philautus horridus</i> .....	517	<i>Rana humeralis</i> .....	427
<i>Philautus larutensis</i> .....	525	<i>Rana (Hylarana) livida</i> .....	468
<i>Philautus</i> .....		<i>Rana (Hylarana) cubitalis</i> .....	424
<i>nongkhorensis</i> .....	523, 531-534	<i>Rana (Hylarana) luctuosa</i> .....	451
<i>Philautus parvulus</i> .....	523-526	<i>Rana javanica</i> .....	430
<i>Philautus pictus</i> .....	506	<i>Rana jerboa</i> .....	462-465, 474
<i>Philautus vittatus</i> .....	523, 529-531	<i>Rana kochangae</i> .....	393-395
<i>Philautus zamboangensis</i> .....	536	<i>Rana kuhlii</i> .....	408-412
<i>Phrynoderma</i> .....	511	<i>Rana labialis</i> .....	433
<i>Phrynoderma asperum</i> .....	511	<i>Rana lateralis</i> .....	427, 443-446
<i>Phrynoderma moloch</i> .....	511	<i>Rana laticeps</i> .....	405-407
<i>Phrynoglossus</i> .....	346, 350	<i>Rana latopalmeta</i> .....	474
<i>Phrynoglossus diminutivus</i> .....	350	<i>Rana lemniscata</i> .....	431
<i>Phrynoglossus laevis</i> .....	353-358	<i>Rana leptoglossa</i> .....	453
<i>Phrynoglossus</i> .....		<i>Rhacophorus leucomystax</i> .....	473
<i>magnapustulosus</i> .....	351-353	<i>Rana limborgii</i> .....	412
<i>Phrynoglossus martensii</i> .....	358-360	<i>Rana limnocharis</i> .....	380
<i>Phrynoidis asper</i> .....	326	<i>Rana limnocharis</i> .....	380-383
<i>Plethodon persimili</i> .....	279	<i>Rana (Limnodytes) luctuosa</i> .....	451
<i>Polypedates annectens</i> .....	345	<i>Rana livida</i> .....	468-471, 474
<i>Polypedates afghana</i> .....	474	<i>Rana luctuosa</i> .....	451-453
<i>Polypedates chloronotus</i> .....	468	<i>Ranidae</i> .....	282, 346
<i>Polypedates hascheana</i> .....	412	<i>Rana macrodactyla</i> .....	421-423
<i>Polypedates leucomystax</i> .....	196	<i>Rana macrodon</i> .....	383-386
<i>Polypedates livida</i> .....	468	<i>Rana macrognathus</i> .....	393
<i>Polypedates maculatus</i> .....	496	<i>Rana macrognathus</i> .....	
<i>Polypedates rugosus</i> .....	496	<i>macrognathus</i> .....	395-398
<i>Polypedates signatus</i> .....	448	<i>Rana masonii</i> .....	462
<i>Polypedates smaragdinus</i> .....	468	<i>Rana miopus</i> .....	427-430
<i>Pseudobufo</i> .....	322	<i>Rana nicobariensis</i> .....	
<i>Rana</i> .....	346, 362	<i>nicobariensis</i> .....	430-433
<i>Rana aenea</i> .....	446-448		

<i>Rana nigrovittata</i> . . . . .	440-443, 453	<i>Rhacophorus reinwardtii</i> . . . . .	487
<i>Rana obsoleta</i> . . . . .	448	<i>Rhacophorus reinwardtii</i>	
<i>Rana plicatella</i> . . . . .	401-405	<i>bipunctatus</i> . . . . .	489
<i>Rana picturata</i> . . . . .	448	<i>Rhacophorus robinsoni</i> , 481, 485-491	
<i>Rana pileata</i> . . . . .	398-401	Rochlen, Donald H. . . . .	271
<i>Rana pullus</i> . . . . .	456	Salamandridae . . . . .	278
<i>Rana raja</i> . . . . .	373-376	Salientia . . . . .	277, 278, 282
<i>Rana ricketti</i> . . . . .	474	Scaphiopus . . . . .	283
<i>Rana rugulosa</i> . . . . .	371-373	Scortecci, Dr. Giuseppe . . . . .	270
<i>Rana scutigera</i> . . . . .	471-473	Scutiger . . . . .	283
<i>Rana signata</i> . . . . .	448-450	Sincsuwan, Sergeant Luan . . . . .	271
<i>Rana tasanae</i> . . . . .	456-459	Sooglossus . . . . .	283
<i>Rana tigerina</i> . . . . .	368	Spea . . . . .	283
<i>Rana tigrina pantherina</i> . . . . .	368	Stahlie, Dr. T. D. . . . .	271
<i>Rana trivittata</i> . . . . .	421	Staurois . . . . .	473
<i>Rana whiteheadi</i> . . . . .	474	<i>Staurois afghanus</i> . . . . .	474-477
Rhacophoridae . . . . .	282	<i>Staurois guttatus</i> . . . . .	474
<i>Rhacophorus</i> . . . . .	480	<i>Staurois jerboa</i> . . . . .	462
<i>Rhacophorus anodon</i> . . . . .	505	<i>Staurois larutensis</i> . . . . .	474, 477-480
<i>Rhacophorus asperrimus</i> . . . . .	419	<i>Staurois natator</i> . . . . .	474
<i>Rhacophorus</i>		<i>Staurois nubilus</i> . . . . .	474
<i>bimaculatus</i> . . . . .	487, 488-491	<i>Staurois tuberilinguis</i> . . . . .	474
<i>Rhacophorus bisacculus</i> . . . . .	494-496	Supachar, Vanijuvadt . . . . .	206
<i>Rhacophorus (Chirixalus) doriae</i> , 537		Suwanarata, Nai C. D. . . . .	271
<i>Rhacophorus (Chirixalus)</i>		Thai provinces . . . . .	272
<i>hansenei</i> . . . . .	523	<i>Theloderma</i> . . . . .	480, 509
<i>Rhacophorus (Chirixalus)</i>		<i>Theloderma asperum</i> . . . . .	511, 514-517
<i>nongkhorensis</i> . . . . .	531	( <i>Theloderma</i> ) <i>bicolor</i> . . . . .	511
<i>Rhacophorus Chirixalus striatus</i> , 531		( <i>Theloderma</i> ) <i>corticalis</i> . . . . .	
<i>Rhacophorus colletti</i> . . . . .	501-504	<i>Theloderma gordonii</i> . . . . .	511-514
<i>Rhacophorus dulitensis</i>		<i>Theloderma horridum</i> , 511, 517-519	
<i>dulitensis</i> . . . . .	493	<i>Theloderma stellatum</i> . . . . .	511
<i>Rhacophorus dulitensis</i>		Thorius . . . . .	275
<i>prominans</i> . . . . .	491-493	Tongyai, M. R. Chakratong . . . . .	271
<i>Rhacophorus leucomystax</i>		Tortonese, Dr. Enrico . . . . .	270
<i>leucomystax</i> . . . . .	496-500, 510	<i>Tropidonotus chrysargus</i> . . . . .	510
<i>Rhacophorus leucomystax</i>		<i>Tylotriton</i> . . . . .	278
<i>sexvirgatus</i> . . . . .	500-501	<i>Tylotriton asperrimus</i> . . . . .	275
<i>Rhacophorus maculatus</i> . . . . .	487, 496	<i>Tylotriton verrucosus</i> . . . . .	274, 279
<i>Rhacophorus</i>			280, 281
<i>nigropalmatus</i> . . . . .	481, 482-485	<i>Uperodon</i> . . . . .	576
<i>Rhacophorus pardalis</i> . . . . .	487	Varavudhi, M. L. Pootipong	
<i>Rhacophorus (Philautus)</i>		<i>Nupartpat</i> . . . . .	269, 271
<i>asperrimus</i> . . . . .	519	Vanijuvadhana, Prof.	
<i>Rhacophorus (Philautus)</i>		<i>Supachai</i> . . . . .	206, 270
<i>bimaculatus</i> . . . . .	534	Vejyant-Rangvrisht, Air	
<i>Rhacophorus (Philautus)</i>		<i>Marshal Muni M.</i> . . . .	270
<i>horridus</i> . . . . .	517	<i>Vibrissophora</i> . . . . .	283
<i>Rhacophorus (Philautus)</i>		<i>Vichian, Dr.</i> . . . . .	271
<i>parvulus</i> . . . . .	523	Wermuth, Dr. Heinz . . . . .	270
<i>Rhacophorus (Philautus) pictus</i> , 506		<i>Xenophrys monticola</i> . . . . .	299, 302
<i>Rhacophorus quadrilineatus</i> . . . . .	500	<i>Xenophrys gigas</i> . . . . .	302
<i>Rhacophorus (R.) colletti</i> . . . . .	501	Young Harold . . . . .	269, 271
<i>Rhacophorus (R.) bipunctatus</i> , 489		Young, Oliver Gordon . . . . .	269, 271